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Baltimore, Md., is following the good example set by St. Louis, Roanoke, Va., and a few other places in securing an accurate and reliable topographical survey of its area as a basis for further municipal improvement. This survey was commenced in June, 1893, under Col. Henry T. Douglas as Chief Engineer, and about $75,000 out of the $125,000 appropriated has been expended. As a basis for accurate standard measurement, a 500-ft. line has been established on Mount Royal Ave. This line is marked at 50 and 100-ft. intervals by monument stones 5 ins. square at the top and sunk 6 ft. into the earth. The line is to be used in testing measuring apparatus. The primary triangulation has been completed and a secondary system is well under way, and a system of precise levels has been established at 400-ft. intervals throughout the city and its annex. A map is being prepared showing 5-ft. contours on a scale of 500 ft. to 1 in. The property map will show the exact location, dimensions and character of every piece of property in the city, with the material of construction in all structures and the purposes of these buildings with names of owners.

The Chicago drainage canal contractors have been since last December fighting for extras for the cemented material met with and which differed, they claim, from what they bid upon and entails greater expense in removal. This cemented clay and boulders require blasting where they bid on earth and gravel. The matter was referred to the committee on engineering and finance, and this committee has now sent in two reports each signed by three members. One report said that the material was fully comprehended in the several contracts and recommended that the contractors be instructed to proceed under penalty of forfeiture of contracts; the other report stated that the material complained of was found on the sections named and recommended that the president associate with himself two members for the purpose of arriving at definite terms of settlement. After a bitter controversy the second report was adopted and the president and his committee will report later. A rock classification would increase the cost on these four sections from $25,000 to $50,000 for each contract.

The New York Post Office handled in the year ending June 30, 1894, 1,336,225,767 pieces of mail matter, divided as follows: Local letters, 289,240,500; received by mail, 51,061,365; foreign despatched, 29,539,375. Local postal cards aggregated 44,498,538; received by mail, 12,705,341; foreign despatched, 1,406,637. Other matter of local origin, 321,785,204; received by mail, 70,883,388; foreign despatched, 55,649,223. A daily average of 18,160 pouches, cases and sacks were handled; or, a daily average of 3,660,893 pieces of mail matter handled. At the General Post Office 1,346,628 money orders were issued and paid, amounting to $10,058,163.54. This does not include 844,941 postal notes, worth $1,243,105.28. At the 40 branch and sub-stations 339,210 money orders were issued and paid, representing $4,650,895.49; and 155,268 postal notes, worth $295,613.79. The aggregate business of the money order department for the year aggregated $103,335,487.83. The net revenue of the office for the year was $4,150,922.46.

An ordinance providing for the elevation of the tracks of the Pittsburg, Ft. Wayne & Chicago Ry. in the city of Chicago will, it is reported, be submitted to the Chicago City Councils early in the fall. It is stated that this ordinance is being drawn at the request of the railway company's officials who desire to elevate certain portions of the tracks in conjunction with the Lake Shore & Michigan Southern Ry. It is also stated that the plans for the elevation of the tracks of the St. Charles Air Line, upon which the engineers have been at work for some time, are nearly completed, and that an ordinance requiring the work to be carried out will be drawn up soon.

The Lake St. Elevated Ry. in Chicago has secured an ordinance allowing the construction of an extension from Market St. east along Lake St. to Wabash Ave., a distance of about 4,500 ft. The conditions of the ordinance are practically the same as those providing for the construction of the main line, that is, only two tracks with the necessary cross-overs, switches and turnouts shall be permitted upon the structure and that the distance c. to c. of tracks shall be but 12 ft. The extension is to be completed within two years. There will be three stations on the extension.

The most serious railway accident of the week was a collision between a light engine and a disabled engine July 27 at Lafayette, Ind., on the Wabash R. R. An engine had broken down in going back for the second section of a parted train, and was run into by another engine sent to its assistance. Three men were killed.——Another serious accident was a collision between two sections of a freight train on the Lehigh Valley R. R., near Ithaca, N. Y., July 30. A coal train of 40 cars broke in two and after putting the first part on a siding the engineman went back for the second section. In making haste to get into the siding to get out of the way of a passenger train the train got beyond control on the down grade and ran into the cars already on the side track. The fireman was killed and the engineman badly injured.

A bridge over Black River, at Black River Falls, Wis., gave way under a threshing engine, July 20. Three men were injured, and the horses were killed.——A wooden bridge at Ontario, Wis., collapsed under the weight of a traction engine, July 21, and the engineman was killed.——A bridge near Sykesville, Md., gave way under a four-horse farm team, July 19, and one man was badly injured. It is said that the bridge had been damaged by a threshing machine which had crossed it a short time before.——A new 20-ft. stone arch at Concordia, Kan., collapsed July 18 while the centering was being struck.

A boiler explosion occurred July 24 in the water-works and electric light station at Perry, Ia., wrecking the building and killing Mr. Hock, the manager of the electric light company.

A large mileage of roads is to be macadamized in Morris county, N. J., the Board of Freeholders having voted on July 26 to issue $350,000 of county bonds for the purpose. A map has been filed with the county clerk showing 182 miles of roads which it is proposed to macadamize.

The city of Lowell proposes to continue its efforts to secure 5,000,000 gallons of water per day from driven wells. Some $75,000 has now been spent in sinking wells, buying land and laying a force main, but the maximum yield secured is 3,300,000 gallons. This was developed by the Cook Well Co., of St. Louis. The water board, of which Mr. Miles F. Brennan is president, now proposes to bring the total expenditure up to $150,000, if necessary, and to ask for bids for a daily supply of 2,000,000 gallons. If the attempt to secure an ample supply from wells fails filtration will be employed and the Merrimac River water continued in use.

The American Iron and Steel Association, through its "Bulletin" of July 25, reports as follows upon the state of the iron trade in the first half of 1894: For this period the total production of pig iron was 2,717,983 gross tons, as compared with 2,561,584 gross tons for the last six months of 1893, and 4,562,918 tons for the first half of 1893. This is a loss of 1,844,935 tons for the same periods in 1893 and 1894. The total for the year ending July 1, 1894, was 5,279,567, as compared with 9,157,000 tons in 1892. We must go back to the dull year of 1885 to find an equally low output. On July 1, 1894, out of 516 furnaces 408 were out of blast. In the first half of 1894 the total production of Bessemer steel ingots was 1,667,454 tons, 1,129,560 tons being made in Pennsylvania. Of Bessemer steel rails, excluding street car and light rails generally, 399,464 tons were rolled, the least rail output since 1879. In the first half of 1893, 2,791,083 tons of ingots and 731,517 tons of rails were produced.

Electric buttons, which can be pressed by the passenger desiring to leave the car, are being put upon experimental cars of the Niagara Falls & Suspension Bridge railway line.

The Nicaragua Canal Construction Company is seeking financial aid in Europe for the building of the canal. Mr. John R. Bartlett, the chairman of the reorganization committee, has sailed to meet by special request several groups of European capitalists, who have expressed a desire to take a hand in the enterprise. In an interview before sailing Mr. Bartlett stated that he was not counting upon congressional action and was organizing a European and American syndicate to complete the work.

The new bridge over Big Black Creek, on the Alabama & Vicksburg Ry., will be a single track structure with a through truss span of 180 ft. and two deck plate girder approach spans of 95 ft. There will be four masonry piers on pile and grillage foundation. The two larger piers will have 78 piles in six rows, spaced 3 ft. to 3 ft. 6 ins. c. to c., with caps 12 × 12 ins. and a platform of timbers 12 × 12 ins., 16 ft. long, laid close, and forming a platform 16 × 42 ft., all timbers secured to the piles by 1-in. drift bolts 22 ins. long. The brick masonry has a base of 38 ft. 6¾ ins. × 12 ft. 7½ ins., battering 1 in 4 for a height of 4 ft., and then ½ in. to 1 ft. to the 15-in. stone belt course, 36 ft. 3 ins. above the grillage. Above this the masonry is 7 ft. 10 ins. × 25 ft. 10 ins., battered ¼ in. to the foot, up to the 18-in. stone coping. This upper part is rectangular, while the lower part has semicircular ends, 25 ft. 11¼ ins. c. to c. of circles. The bottom radius is 3 ft. 11 ins., and the top radius 5 ft. 3⅜ ins. Mr. G. B. Nicholson, M. Am. Soc. C. E., of Cincinnati, O., is Chief Engineer, and proposals for the work will be received until Aug. 10 by the president, Mr. C. C. Harvey.

A sextuple photographic telescope has been made for Yale observatory by Warner & Swasey, of Cleveland, O., and is to be used in photographing meteoric displays, the six cameras together covering a field equal to 2,400 full moons. This telescope is unique in certain respects and was devised by Dr. W. L. Elkin, of Yale College observatory. Each camera carries a plate covering a space of 10° square in the heavens and the fields are so arranged as to touch each other at the edges, so that the total field will cover 600 sq. degrees. It will be used in connection with two single telescopes placed at a distance of two miles from the sextuple instrument with electrical connections for simultaneous photography.

A 1-ct. fare for short distances, with 3 cts. for long rides, has been established in Savannah, Ga., as the result of a war between rival street railway companies. The president of one of the companies says his line has taken in more money during the past two months under these low fares than in any two months under the old rates of 5 cts. for all distances. He threatens to make the new rate permanent; but as the warring lines parallel each other and there is only legitimate business for one, all statements of this kind must be taken accordingly.

The Ingersoll rock drill, whose inventor, Mr. Simon Ingersoll, died July 24, as noted in our Personal column last week, was invented in 1870. In a recent letter to Mr. W. L. Saunders, Engineer of the Ingersoll-Sergeant Drill Co., Mr. Ingersoll described the origin of the drill and his early trials in perfecting it. It seems that the demand came to him in May, 1870, from Mr. Joshua D. Miner, a contractor. Mr. Miner saw Ingersoll's stone-breaker, and suggesting a steam rock-drill as a very desirable invention, Mr. Ingersoll undertook to design one, and went to work with money provided by Mr. Miner. The first drill was built at the Tubal Cain Works, in Brooklyn, and cost $212. It broke down on trial, but proved its possibilities, and others were built with improvements. The first patent was taken out on May 30, 1871; followed by the spiral bar patent on Oct. 24, 1871. The only steam drill in the market at that time was the Burleigh, a comparatively clumsy affair 10 ft. 6 ins. high. The "no-piston rod" drill was patented by Ingersoll in April, 1888, and has been since improved. Mr. Ingersoll's health failing him he sold out to Mr. Miner, in 1871, his whole interest in the drill for $5,500, and since that time the drill has been much improved by Mr. Sergeant.

Irrigation pays about Boise, Idaho, says a correspondent of the Salt Lake "Tribune." Ten years ago the plains south of Boise were covered with sage brush and the whole country was a wilderness. Now, nearly all of this land is taken up and the larger part is under cultivation, thanks to the Boise irrigation canal. This canal, 40 ft. wide in the main channel, is, with its laterals, over 200 miles long and waters 100,000 acres.

STONY CREEK ARCH, CANADIAN PACIFIC RAILWAY.

(With Inset.)

We illustrate in the accompanying cuts and on our inset sheet this week the general details of the 336-ft. steel arch bridge which the Canadian Pacific Ry. Co. completed in 1893 over the deep gorge of Stony Creek, at the summit of the Selkirk Mountains, in British Columbia. This structure carries a single line of railway track and replaces the old Howe truss bridge with its tall wooden trestle piers, which will be remembered by those who have seen this somewhat noted crossing, and which was built when the line was first carried through the mountains. The general character of the crossing and the picturesque scenery of the surrounding country are very clearly shown in the views of the partly completed structure which are given. It may be noted also that the second view, Fig. 2, gives a pretty good idea of the general character of the line for some distance as it climbs along the mountain side toward the East.

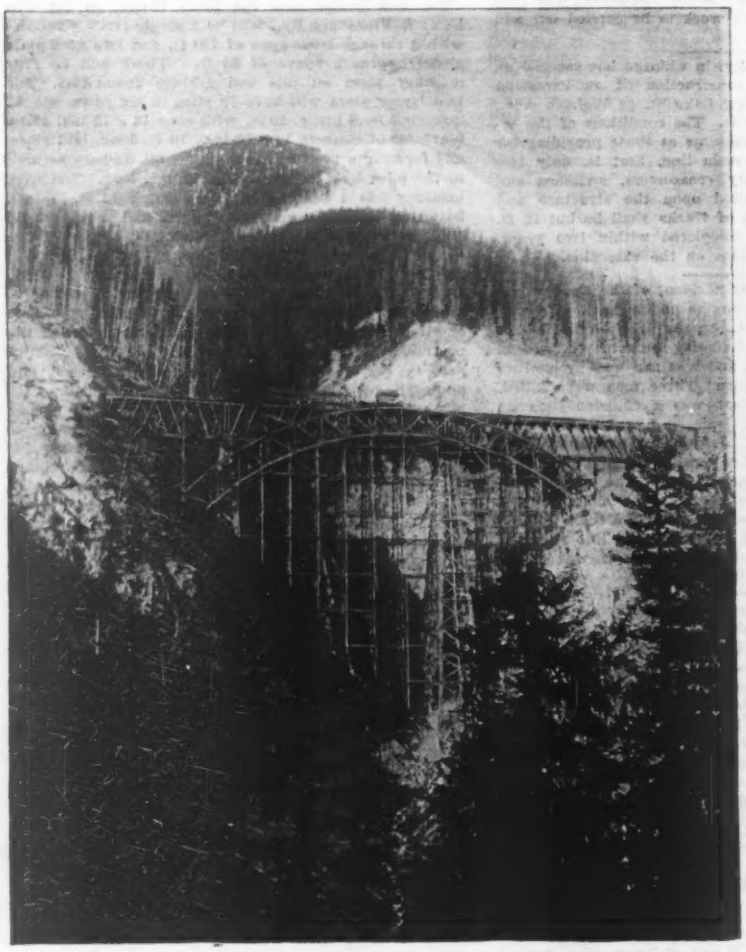


FIG. 1. STONY CREEK ARCH, NEAR SUMMIT OF SELKIRK MOUNTAINS, CANADIAN PACIFIC RY., VIEW SHOWING FALSEWORK IN POSITION.

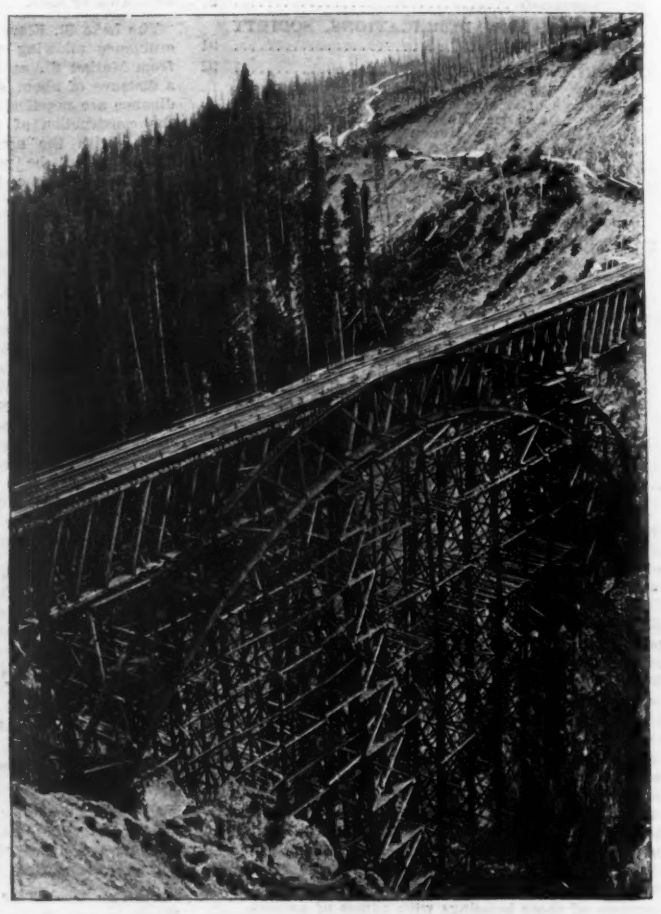


FIG. 2. VIEW OF ARCH SHOWING CONTINUATION OF RAILWAY LINE EAST ACROSS THE RANGE.

As stated above, the bridge consists of an arch of 336 ft. span and 100 ft. rise, supporting a superstructure 483 ft. long c. to c. of abutments, or 484½ ft. long over all. The height from the bottom of the gorge to the base of the rail is about 300 ft. and to the intrados of the arch 280 ft. These dimensions compare with those of other high arch bridges as follows:

Name and location.	Span, feet.	Height, feet.
Stony Creek Gorge, Br. Columbia.	336	280
Cerveyrette, France	172.2	279
Garabit, France	540	406
St. Giustina, Tyrol	197	460
Du Viaur, France	...	382
Douro, Portugal	....	201

A general plan and elevation of the bridge are shown in Fig. 4; Fig. 5 shows a side elevation and development of the arch and the general arrangement of the lateral bracing; the inset gives general details of the arches, columns and trussed superstructure, and Fig. 6 full details of the shoes and pedestals at the abutments. Figs. 1, 2 and 3 are views from photographs of the partly completed structure.

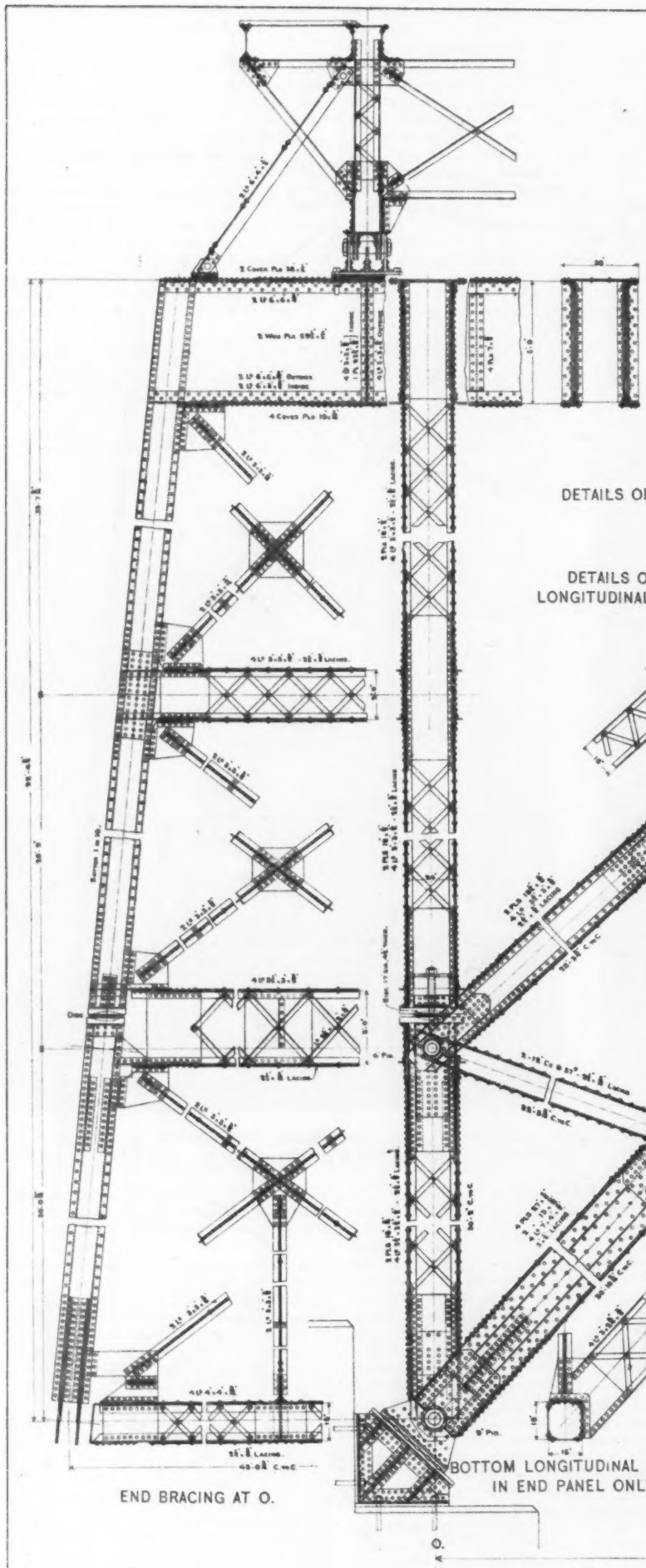
The entire structure is built of steel, all of which was manufactured in England and shipped to Canada, to be worked up by the Hamilton Bridge Co., Limited, of Hamilton, Ont., according to the standard specifications of the Canadian Pacific Ry. Co. These specifications provided for the dead load of the bridge and a live load of two consolidation locomotives, with the wheel loads and spacing shown in the diagram (Fig. 5), followed by a train load of 3,000 lbs. per lin. ft. The top and bottom lateral bracing was calculated to resist the stress of a lateral force of 30 lbs. per sq. ft. on the surface of the train averaging 12 sq. ft. per lin. ft. of train, and also on a surface equal to twice the surface of the elevation of the bridge. The 360 lbs. pressure on the train was to be treated as a moving load and the pressure on the bridge as a static load. The laterals were also to be calculated to resist a strain of 50 lbs. per sq. ft. on a surface equal to twice the surface of the elevation of the bridge, and the maximum stress taken in each case. The stresses on the bridge were assumed to be applied to each panel point of the top and bottom chords and those on the train at a height of 7 ft. above the base of the rail.

The strain in the chords from the assumed wind force, arising from wind displacement (capsizing) and direct wind (transverse) stress was to be taken into account only when it exceeded one-fourth of the maximum fixed strains for dead and live loads, when the sections should be increased until the total stress per sq. in. should not exceed more than one-fourth the maximum stress fixed for dead and live loads only. The bridge in all its parts was to be capable of resisting the greatest tractive force of the locomotives, or any force induced by suddenly stopping upon any part of the structure the assumed maximum loads, the coefficient of friction of the wheels on the rails being assumed as 0.20%. The rivets and bolts connecting the parts of any member were to be so spaced that the shearing strain per square inch should not exceed 7,500 lbs., or three-fourths the allowed tension per square inch upon that member; nor should the pressure upon the bearing surface per square inch of the projected semi-intrados of the rivet or bolt hole exceed 12,000 lbs., or 1½ times the allowed tension per square inch upon that member. In the case of field riveting or splice riveting the above limits of shearing strains and pressure were to be reduced one-third. Pins were to be so proportioned that the shearing strains should not exceed 9,000 lbs. per sq. in., and the crushing strains not over 14,000 lbs. per sq. in., and the bending strain not over 20,000 lbs. per sq. in., when the centers of bearings of the strained members were taken as the points of application of the strains.

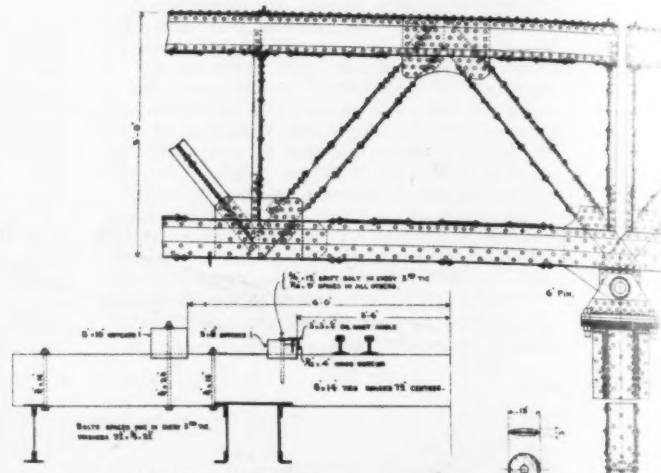
The specifications for the steel required that it should not contain more than 0.065 of 1% of phosphorus nor more than 0.5 of 1% of manganese, and should show the following requirements in testing: An ultimate strength of from 58,000 to 65,000 lbs., an elastic limit of 33,000 lbs., an elongation in 8 ins. of 20%, and a reduction of area of 40%. Holes ¾ in. in diameter, punched 1 in. from the edge, in universal plates or shapes and 1½ in. from the edge in sheared plates, were to stand drifting, with a 1 to 12 drift, to a diameter of 1½ ins. without showing cracks at either the periphery of the hole or edge of the plate. The specifications for the workmanship, inspection, painting, etc., did not differ materially from those of ordinary first-class work.

Turning to the bridge itself, the general design and construction are so clearly shown by the drawings as to need no description. Attention may be called, however, to the use of thimbles in the lower chord connections to facilitate the erection, and the disk joints in the vertical posts which allow for the expansion and contraction of the trussed superstructure.

As stated before, the material was ordered from Europe from different makers, and work was commenced in the shops as soon as it arrived complete for any part of the bridge. One-half of one truss



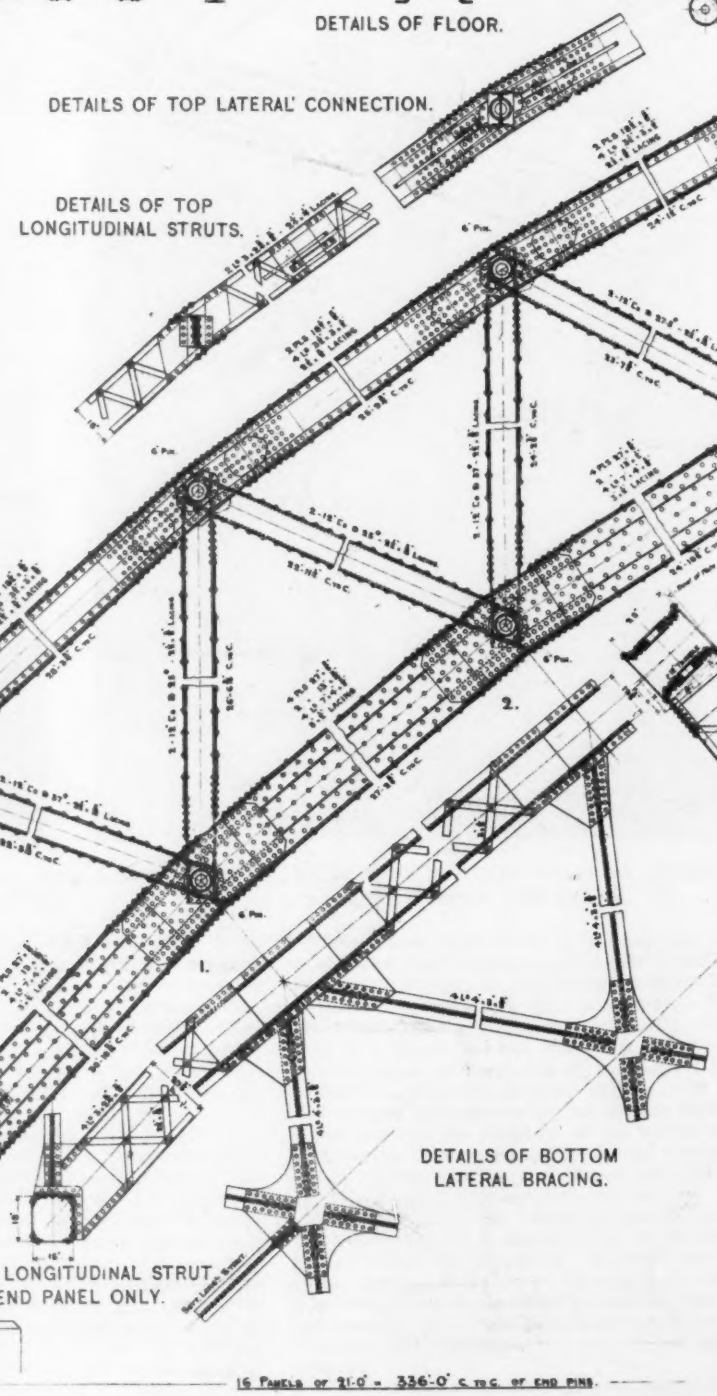
END BRACING AT O.



DETAILS OF FLOOR.

DETAILS OF TOP LATERAL CONNECTION.

DETAILS OF TOP LONGITUDINAL STRUTS.



DETAILS OF BOTTOM LATERAL BRACING.

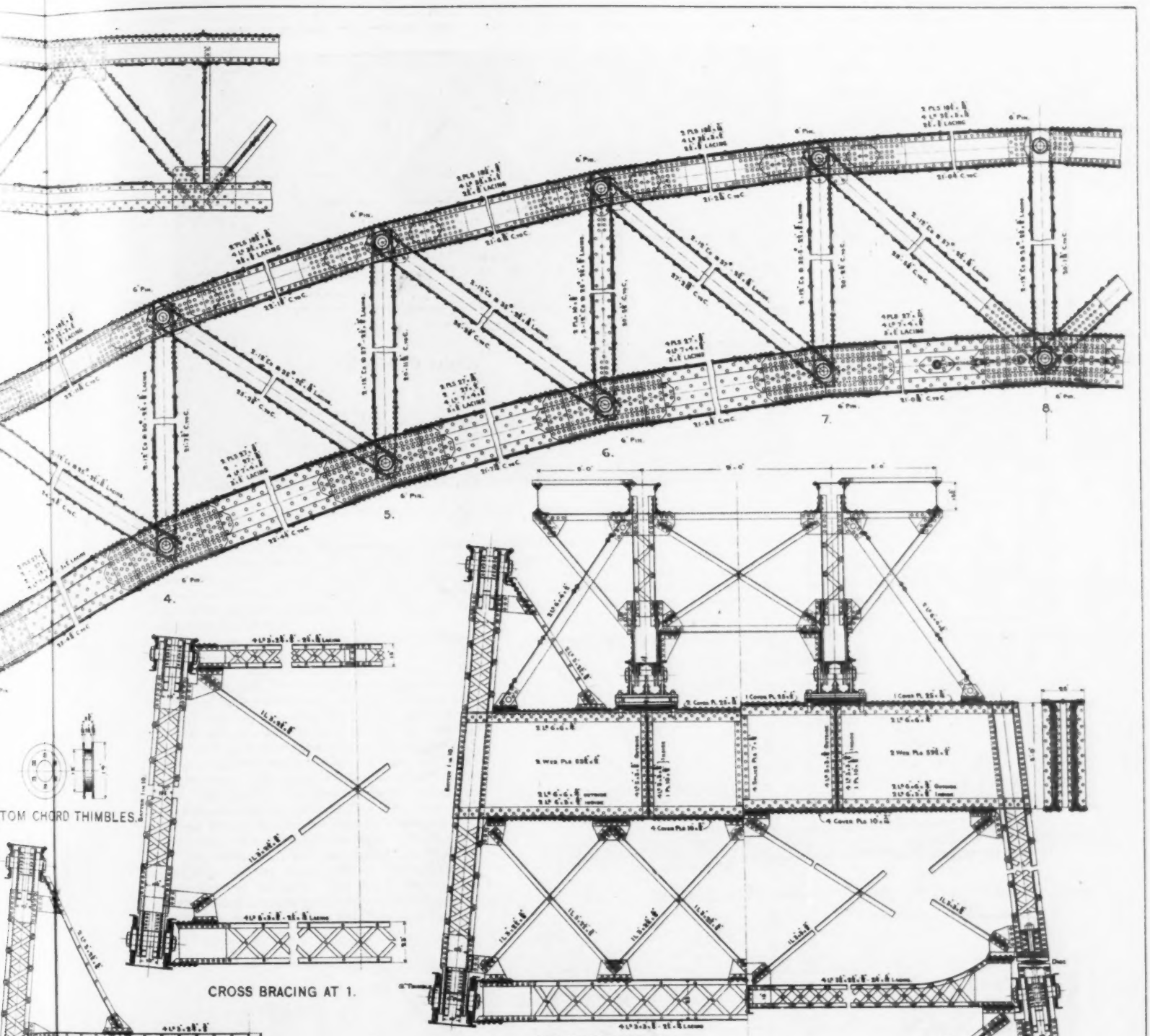
BOTTOM LONGITUDINAL STRUT IN END PANEL ONLY.

BOTTOM CHORD

16 PANELS OF 21'-0" = 336'-0" C. TO C. OF END PINS.

STONY CREEK ARCH, CAN

P. Alex. Peterson, M. Am. Soc. C. E., Chief Engineer.



TOM CHORD THIMBLES.

CROSS BRACING AT 1.

CROSS BRACING AT 6.

CROSS BRACING AT 3.

CROSS BRACING AT 7.

CROSS BRACING AT 8.

RCH, CANADIAN PACIFIC RY.

ineer. Hamilton Bridge Co., Limited, Hamilton, Ont., Contractors.

CHAS. HART & SONS, LITH., 25 VESEY ST., N. Y.

was connected together at the works, also different sections of cross bracing and laterals, before being shipped, to ensure the accurate fitting of the differ-

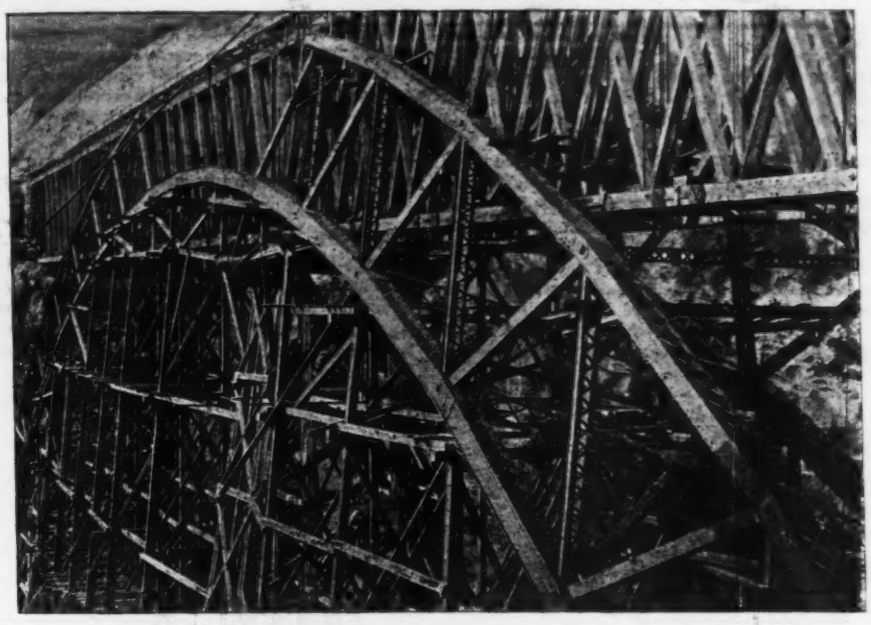


FIG. 3. VIEW SHOWING MANNER OF SUPPORTING ARCH ON FALSEWORKS.

ent parts during erection. The trusses of the 63-ft. and 84-ft. spans of the superstructure were shipped in one piece all riveted up, and the whole material finished ready for erection was transported nearly 2,000 miles over the Canadian Pacific Ry. without damage to any of it.

The erection was attended with unusual difficulties on account of the great height of the bridge, the extremely dangerous nature of the walls of the gorge, the limited room for handling material near the bridge, and the necessity of keeping trains running on the old structure during the erection of the new bridge. As will be seen from the illustrations, the falseworks were built in bents, about 21 ft. apart, of four posts braced laterally, and with cross-bracing. The lower section, about 45 ft. in width, was carried up vertically to the height of the springing line of the arch, but the outer posts of bents above that height had the same batter as the trusses. These falseworks were carried up to and supported the old truss during its removal. Caps were left at proper heights to receive the lower chord of the arch. The lower chord of the arch was first erected, the design being such as to permit this, as will be seen from the drawings.

The pins connecting the several members of the lower chord, being spools 12 ins. in diameter, transfer the stresses direct from one member of the bottom chord to the other by direct contact and at the same time allow a slight rotary motion to the members, thus simplifying the erection of the trusses very materially and diminishing the thickness which the use of a 6-in. pin alone would have rendered necessary. The rest of the truss members were connected afterward in the usual manner by pins, which in the lower chords pass through the 12-in. spools already in place. The pedestal on which the shoe rests is also formed so that a slight motion can take place transversely without undue strain on the pier members.

The individual spans of the superstructure were completely riveted up on the bank and brought on to the falseworks and lowered into position in intervals between trains. It took from five to eight hours to bring the span on to the bridge, by means of the erecting car, and to block it up while the old span and track were removed enough to allow the new span to be lowered. The lowering was done by blocking up the span at one end and lowering the other end, by means of a derrick, between the trusses of the old bridge and then putting on the ties and track rails ready for trains. Two adjoining spans are connected on the same pin, but have different shoes, so that they can have independent motion.

The view of the whole design was to reduce to a minimum all internal stresses due to change of temperature. This is provided for by placing disks at the foot of every upright post supporting the superstructure on the arch. This construction also affords perfect transverse stiffness. Under a live load of six 100-ton locomotives steaming up grade at a speed of 20 to 25 miles an hour, the arch deflected 1¼ ins. and had a lateral vibration of ⅛ in. Under an ordinary train with an engine in front and a pusher, going up grade at a speed of 20 miles an hour, the deflection was ⅜ in. and the amplitude of lateral vibrations was 3-64 in.

The only derrick used in erection was of a simple character, being a double drum hoisting engine capable of carrying 10 tons on each drum, placed on a heavy 80,000-lb. car with a braced frame, from which was swung a boom on each side, so that both

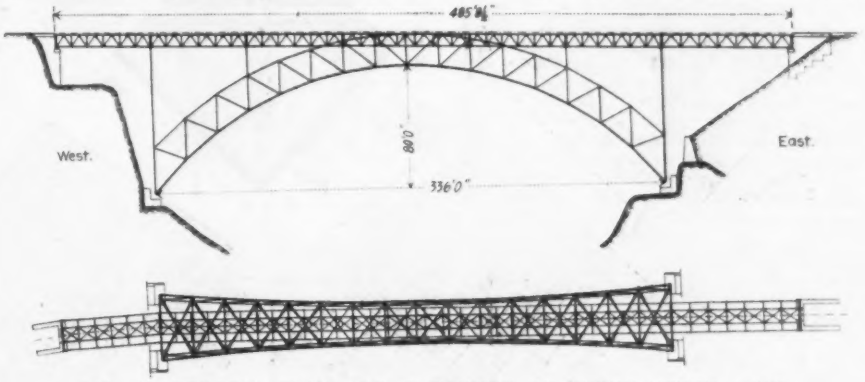


FIG. 4. GENERAL PLAN AND ELEVATION OF STONY CREEK ARCH.

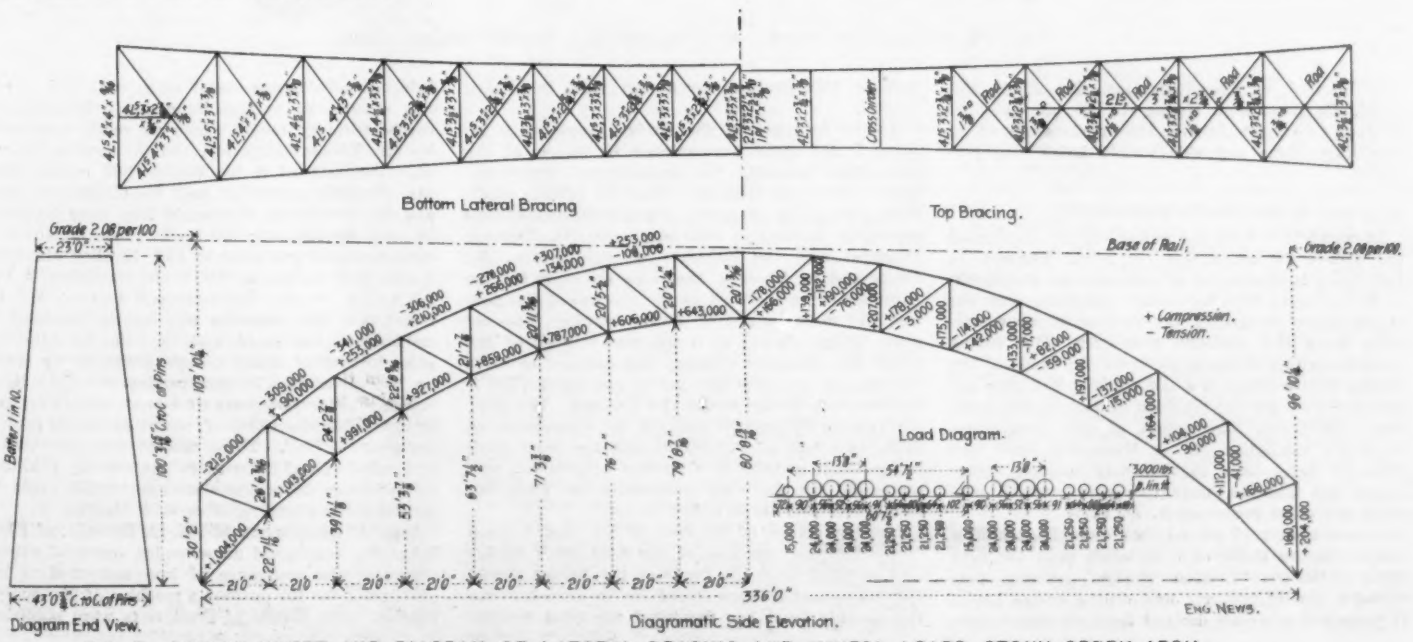


FIG. 5. STRAIN SHEET AND DIAGRAM OF LATERAL BRACING AND WHEEL LOADS, STONY CREEK ARCH.

trusses were erected at the same time. Locomotion was given to the car by the same engine, and steam was supplied by the boiler to the steam riveter for fieldwork on the arch. The erection of the falseworks was completed in 46½ days. The erection of the arch was commenced Aug. 11 and it was connected complete on Sept. 13, 1893, when the supporting wedges were removed. The trains passed over entirely on the new structure in the early part of November, 1893. The work of removing falseworks and old spans had to be suspended soon after, on account of a heavy fall of snow, but was completed in the spring. The total amount of lumber in the falseworks was 265,000 ft. B. M. and 10,500 lbs. of bolts, etc., were used. The weight of steel work in the arch proper, including the vertical supports, is 1,048,200 lbs. The total weight of steel in the bridge is 1,543,000 lbs. The bridge was designed by Mr. P. Alex. Peterson, Chief Engineer, Canadian Pacific Ry., and the construction and erection were done by the Hamilton Bridge Co., Limited, of Hamilton, Ont., Mr. J. A. McNicol, Engineer and Manager. We are indebted to these two gentlemen for the matter from which our illustrations and this article have been prepared.

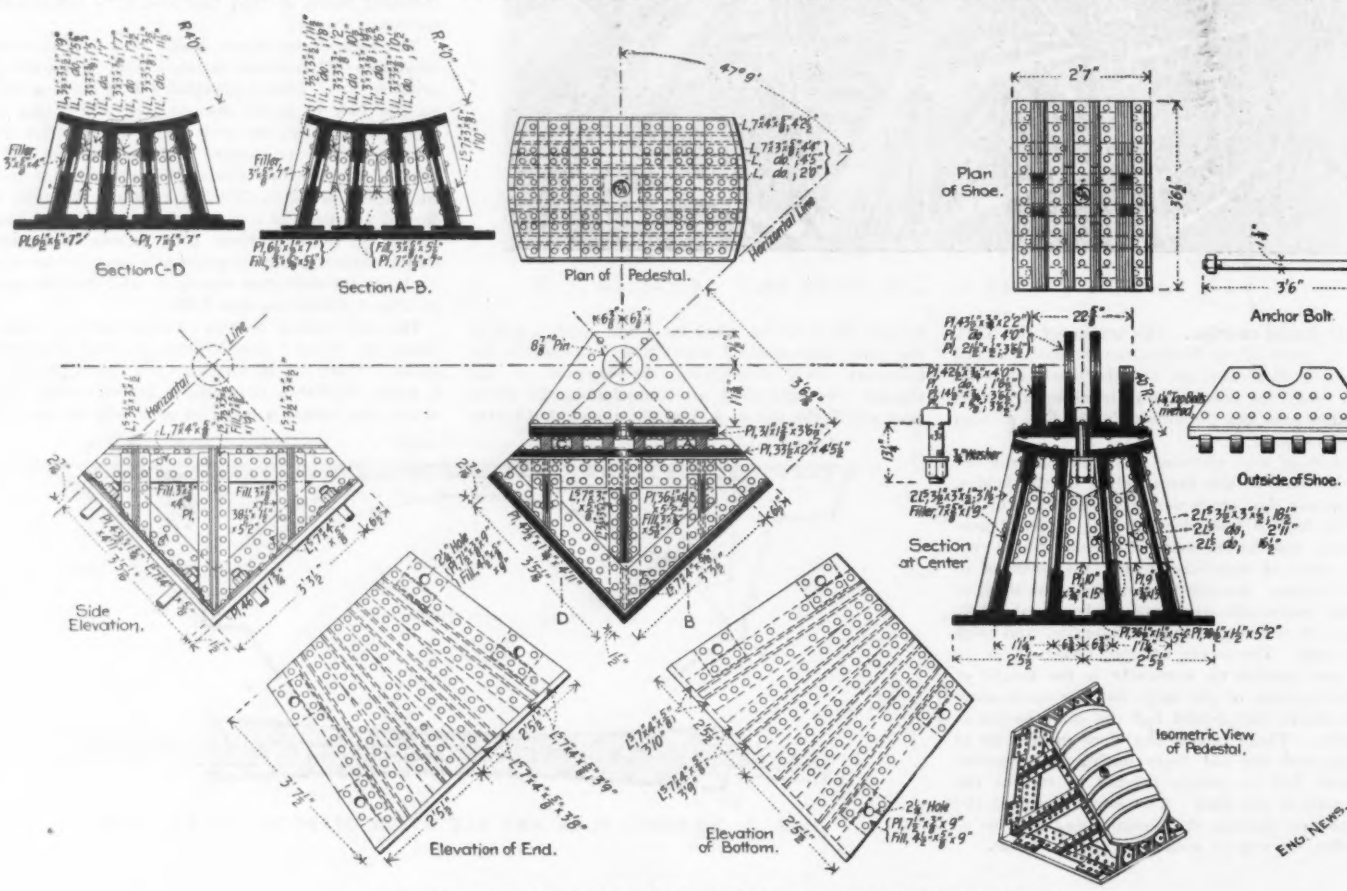


FIG. 6. DETAILS OF SHOES AND PEDESTALS, STONY CREEK ARCH.

A 700-YEAR-OLD TRUST.

In connection with the recent official opening of the Tower Bridge, across the River Thames, in London, it is interesting to note that the $5,000,000 expended upon this handsome structure was not raised either by a City tax rate or by appropriations from the national exchequer. The money spent upon this bridge came from the funds of the Bridge House Estates, a trust which has been administered by the Corporation of London for more than 718 years. The origin of this trust antedates the institution of the Mayoralty itself and probably dates back to the early wooden bridge across the Thames, near this point, which preceded the stone bridge of A. D. 1176.

It is a matter of record that more than half a century before Peter of Colechurch built the first stone structure, "London Bridge" already possessed a goodly property and rented bridge lands. It possessed revenues derived from charitable contributions and from grants of tolls and taxes made by the Saxon and Early Norman Kings. The worthy priest, Peter of Colechurch, besides designing and superintending the work of constructing, which lasted 33 years, is said to have built at his own expense the chapel which stood upon the old bridge.

The supreme control of the bridge and all its affairs was vested in the Corporation of London acting through the Court of Common Council and the Court of Aldermen. The accounts of the bridge were audited annually by a committee made up of two Aldermen, appointed by the Mayor and Aldermen, and four commoners, elected by the people, though the make-up of this committee varied from time to time. An important source of revenue was the tolls for vehicles and the passage of ships. Certain people compounded their tolls, and "berebruers," in the reign of Edward IV., paid 6s. 8d. annually for each vehicle. In 1460 a toll of 2d. was charged for a cart with unshod wheels, and 2s. was charged for a cart with iron-bound wheels.

As the revenues of the Bridge House trust increased and sums accumulated in excess of the immediate demands for maintenance, appropriations were made from this trust for various charitable and public purposes. Among the institutions especially favored in this way were St. Thomas' Hospital and the churches of St. George, St. Olave and St. Thomas, the sums set aside for the churches being specified as for the use of the poor and the maintenance of divine service. The old stone bridge, clumsy as it was and in need of frequent and extensive repairs, was destined to serve its purpose for over 650 years, and until 1750 it was the only bridge across the Thames. The present London bridge was built by the Corporation in 1831, at a cost of $2,130,000, and the Southwark bridge, built in 1819 by a private corporation, was purchased by the City authorities in 1868, for $1,000,000, and made a free bridge.

Just how much of the cost of the new London bridge and the purchase of the Southwark bridge was provided from the funds of the Bridge House Estates cannot be here stated, as data are lacking. But as this trust has furnished the total amount expended upon the new Tower Bridge its present revenue must be great from other sources than the now abolished tolls. From all that can be now learned this trust has been efficiently and honestly administered for over seven centuries; and the fact that there is value left to administer, after all the vicissitudes of wars, revolution and the official corruption which was characteristic of the courts of the later kings, speaks volumes for the sturdy honesty of those who throughout all these centuries have controlled the affairs of the Corporation of London. It is a most honorable record, and one only too rare in later municipal history.

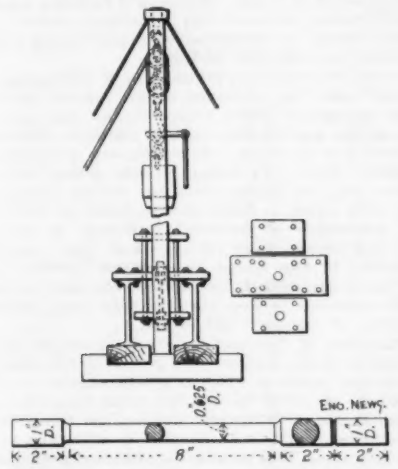
TESTING IRON AND STEEL BY IMPACT.

While it is well known that under the conditions in which iron and steel are used in engineering structures the metal must often withstand the impact of suddenly applied loads, very few experiments have ever been made to determine the actual behavior of either material when subjected to sudden stresses of various intensities. The first recorded tests by impact which we recall were made by Mr. Thomas Kirkaldy, and the results obtained were summarized in his famous "66 conclusions." Mr. Kirkaldy found that both the ultimate strength and the elongation of wrought iron were decreased by suddenly applying the load. Some impact tests were made on gun steel by Col. Eardley Maitland, Assoc. Inst. C. E., in 1885-6 and published in Vol. LXXXIX. of the "Proceedings," Inst. C. E. He found that the elongation was largely increased by suddenly-applied loads, and that the fracture was silky instead of being always granular, as stated by Mr. Kirkaldy. In constructing the East River bridge a few experiments were made upon steel bars to determine the effect of variation in the rate of applying the load. These showed that bars broken in 3 minutes and 20 minutes respectively exhibited no difference in ultimate strength which could be attributed to either rapid or slow loading.

Some 18 months ago Mr. E. D. Estrada, of Pittsburg, Pa., conducted an extended series of experiments on the resistance of iron and steel to impact, using for the purpose a machine of his own invention. The details of these tests were published

in the "Proceedings of the Engineers' Society of Western Pennsylvania" for June, 1893, and quite full discussions of the results were given in succeeding numbers for September and November. The following is a much condensed abstract of the paper and discussion:

Testing Machines and Material Tested.—The machine used by Mr. Estrada is shown in the accompanying illustration. The manner of holding the test pieces and the general design of the machine will be evident from the engraving. The plate which holds the chuck in which the upper end of the test piece is inserted is of iron and measures 22 × 9 × 1¾ ins. It rests on two 15-in. I-beams, spaced about 9 ins. between inside flanges. These in turn rest on timbers. The plate which takes the chuck at the lower end of the test piece is 8 × 12 × 1½ ins., and the upper plate, on which the falling weight strikes, is 8 × 12 × 2 ins. The four steel rods



Machine for Making Impact Tests Designed by E. D. Estrada, C. E.

which transmit the force of the blow from the striking plate to the lower end of the test piece are 1¼ ins. in diameter and 18 ins. in length. The chucks which take the ends of the test piece were of hard steel, each 3 ins. long and 3 ins. in largest diameter. The hammer weighed 100 lbs., fell between guides, and could be dropped from any desired height up to 25 ft. Mr. Estrada says:

> It will not be necessary to discuss here, in detail, the dimensions of the other parts of the apparatus. Suffice it to say, that they were so proportioned as to allow the effects produced by the "drop" to be apparent in the specimen, and not in any of the other parts of the apparatus, of which the specimen forms an integral part.*

The form and dimensions of the test pieces used are shown also in the cut. These were all turned in a lathe from material manufactured by Pittsburg, Pa., firms, but not manufactured especially for these tests. The nick at the right end of the test piece was made so that the end might be broken with a sledge to ascertain the appearance of a fractured surface. Especial care was taken to locate the part of the bar from which each test piece was cut. The original length of 8 ins. was marked on each specimen by two carefully laid-off punched marks, and the elongations or permanent sets produced on each specimen after fracture or after the application of any load were measured by the difference between the original distance and the one considered.

Ten different qualities of iron and steel were tested, comprising rivet iron, several samples of ordinary structural iron, common merchant steel and nickel steel. In the accompanying tables are shown the records and results of the tests made on common merchant steel (Table I.), nickel steel (Table II.), and wrought iron from structural works (Table III.). These three series of tests have been selected from the numerous tables accompanying the paper as typical of the results obtained in all. In discussing the results of his experiments, Mr. Estrada says:

> In a treatise upon the "Elasticity and Resistance of the Materials of Engineering," the following statement is made:
>
> If tensile stress is suddenly applied to a bar of wrought iron, both its ultimate resistance and elongation will be very materially decreased. As a mean of a number of tests, Mr. Kirkaldy found, with suddenly applied stress, an ultimate resistance of 46,500 lbs. per sq. in., while with gradually applied stress it rose to 57,200 lbs. In the former case, the elongation was about 20%, and in the latter as high as 24.6%. Thus it is seen that the mode of application of external force affects not only the character of the fracture of the iron, but also its ultimate resistance and elongation. It will hereafter be seen that similar observations apply to other metals.

* Especial attention is called to this quotation in connection with Professor Johnson's remarks in the discussion and the comment on our editorial page.

TABLE I.—Tests of Common Merchant Steel.
(Temperature 70° F.)

Drop in feet.	Elong. in ins.	Difference.	Drop in feet.	Elong. in ins.	Difference.
Test piece 1.					
1	0	0	11	1.35	0.19
2	0.02	0.02	12	1.64	0.29
3	0.07	0.05	13	1.94	0.30
4	0.20	0.13	Test piece 4.		
5	0.31	0.11	19	0.50	....
6	0.42	0.11	20	0.90	0.40
7	0.59	0.17	20	1.31	0.41
8	0.74	0.15	20	1.72	0.41
9	0.95	0.21	11	1.94	0.22
10	1.16	0.21			

Comparison of Impact Tests and Tensile Tests.

No. of test piece.	Total ft.-lbs. per sq. in.*	P. c. reduction of area.	P. c. elongation in 8 ins.	Fracture.
Impact test.				
1.	29,416	29.28	24.25	Granular, silky at center.
4.	29,060	37.61	24.25	Silky, perfect cup.
Tensile test.				
Ave. of 2 tests	27.89		14.0	Silky, perfect cup.

* The quantities under this heading represent the total foot-pounds of energy obtained by adding the foot-pounds produced in the successive falls of the weight, divided by the cross-section of the test piece. It will be evident that the quantities in this column and in the similar columns in tables II. and III. are dependent on whether the weight was dropped a large number of times with a small fall or a small number of times with a large fall.

TABLE II.—Tests Made on Nickel Steel.

Drop in feet.	Elong. in ins.	Difference.	Drop in feet.	Elong. in ins.	Difference.
Test piece 3. (Temperature 40° F.)			Test piece 4. (Temperature 48° F.)		
20	0.34	0.34	25	....	....
18	0.65	0.31	25	....	....
25	0.98	0.33	25	....	....
25	1.35	0.37	25	....	....
25	1.75	0.40	25	2.90	....
25	2.08	0.33			
25	2.25	0.17			

Comparison of Impact Tests and Tensile Tests.

No. of test piece.	Total ft.-lbs. per sq. in.	P. c. reduction of area.	P. c. elongation in 8 ins.	Fracture.
Impact test.				
3.	39,113	56.32	28.12	Coarse, jagged, ½ cup.
4.	40,743	55.49	28.75	Silky, half cup.
Tensile test.				
Av. two tests.	47.03		17.50	Coarse, 45°.

TABLE III.—Tests on Wrought Iron for Bridge Work.

Drop in ft.	No. of test piece. 2	4	8	12	15	No. of test piece. 2	4	8	12	15
	Total elongation, ins.					Incr. of elong., ins.				
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0.02	0.05	0	0.02	0	0.02	0.05	0	0.02	0
4	0.09	0.14	0.07	0.07	0.05	0.07	0.09	0.07	0.05	0.05
5	0.20	0.30	0.16	0.16	0.13	0.11	0.16	0.09	0.09	0.08
6	0.36	0.45	0.30	0.30	0.33	0.16	0.15	0.14	0.14	0.20
7	0.56	0.65	0.46	0.46	0.51	0.20	0.20	0.16	0.16	0.18
8	0.75	0.85	0.64	0.66	0.61	0.19	0.20	0.18	0.20	0.10
9	1.00	1.13	0.85	0.88	0.91	0.25	0.28	0.21	0.22	0.30
10	1.22	1.37	1.06	1.12	1.16	0.22	0.24	0.21	0.24	0.25
11	1.50	1.70	1.34	1.34	1.41	0.28	0.33	0.28	0.22	0.25
12	1.84	2.00	1.62	1.65	1.66	0.34	0.30	0.28	0.31	0.25
13	2.22	2.34	1.92	1.92	2.08	0.38	0.34	0.30	0.27	0.42
14	2.60	....	2.14	2.32	2.32	0.38	....	0.22	0.40	0.24
15	3.00	....	....	2.58	2.55	0.40	....	....	0.26	0.23
16	3.35	....	....	....	2.80	0.35	....	....	....	0.25

Comparison of Impact Tests and Tensile Tests.

No. of test piece.	Total ft.-lbs. per sq. in.	P. c. reduction of area.	P. c. elongation in 8 ins.	Fracture.
Impact test.				
2	44,619	52.28	41.87	Fiber, jagged
4	29,856	32.44	20.25	" sand spot
8	34,440	47.24	26.75	"
12	39,370	37.63	32.25	"
15	43,307	42.58	35.00	" irregular
Tensile test.				
Ave. of six tests.	43.56		25.27	

The experiments here described show that by a suddenly applied load the elongations are very materially increased. It has also been stated by an authority on the subject, that "steel invariably presents, when fractured slowly, a silky, fibrous appearance; when fractured suddenly the appearance is invariably granular." The same authority states that "iron, when fractured suddenly, invariably presents a crystalline appearance; when fractured slowly, its appearance is invariably fibrous." These statements would be correct if the word "some" had been prefixed to the words "iron" and "steel." In this connection, there is a peculiar case which should not escape your notice: Test piece 4, Table I., tested by the "drop," shows a fine, granular fracture at 90° to the axis of the piece, while test piece 1 shows a silky, cup-fracture; yet the elongations in both cases are identical. The relation between the elongations and the reduction of area appears to be dependent upon the quality of the material.

With regard to the effect of temperature, the experiments show that all iron is not affected alike by increase or diminution of temperature, but that some iron is greatly affected, while other grades are very slightly so, at least between the ordinary ranges of the atmospheric temperature in this latitude.

The most important of all the features brought out by these experiments undoubtedly is that the elastic limit is a variable quantity, depending upon the conditions under which the loads are applied. Some writers state that "there is a limit of strain within which iron is practically indestructible, and that it is a little over 30,000 lbs. per sq. in. for the best grade of iron." This statement does not seem to be verified when the results here given are considered. An examination of the tables here given, containing the effect produced by each drop, shows that in many cases a drop of 2 ft. was sufficient to obtain a permanent set, and, it is likely that with more accurate means to measure the effect, a drop of 1 ft., and even less, would have been sufficient to have reached the elastic limit.

One of the tests shows one characteristic which is worthy of especial note. The test pieces used in it were made from the bolts that supported the test piece in the drop machine. The bolts were in use for two months, during which they had been subjected to the work of about 50 tests. Comparing the results of the screw-tests of this material with the average results of the tests on pieces cut from new material, there is nothing to indicate that the metal had been impaired by the previous work done in the machine. Its ultimate strength, reduction of area and elongation all make a very favorable showing, and on the strength of that test this material would be accepted for any use for which good iron is wanted. But in the drop-test the result is entirely different. The ultimate strength and reduction of area are only about one-half the average of the other tests, and the elongation but little more than one-half, showing very decidedly the effect of the previous work. On this test the material would be rejected as unfit for further use.

The number of tests made on pieces cut from these bolts was not enough to warrant the announcement of a general principle; but the difference was too striking to be wholly accidental. The writer now contemplates a series of tests to further develop this point, and hopes to be able to establish a special field of usefulness for the drop-test in determining the service value of existing bridges, and the probable life of iron and steel structures in general.

Discussion.

Mr. T. H. Johnson.—Mr. Estrada's experiments seem to lead to one point, at least, which differs from the text-books, in that we have always been taught to look upon the elastic limit as a definite property of the material, bearing a nearly constant relation to its ultimate strength, while these tests go to show that it is not a fixed property of the material, but is variable with the conditions of test. In the ordinary testing machine, the load is applied gradually, starting from zero and attaining full load only at the end of the test. With Mr. Estrada's drop-test the load is applied instantly, as a sudden blow. In the former case we find a so-called elastic limit, within which there is no permanent set, and beyond which the rate of stretch increases rapidly up to the point of rupture. In the latter case, we find a decided permanent set with the first blow of the drop, even with a fall as low as 2 ft. (200 ft.-lbs.), and the rate of stretch is constant throughout the test.

We have, therefore, in the one case, an elastic limit at ½ to ⅔ of the ultimate strength; and in the other case, this limit dropping to about zero. The material is the same in both cases. The difference is wholly in the mode of applying the load. We can, therefore, no longer regard the elastic limit as a property of the material, but as a function of the conditions of the test. This is directly at variance with accepted principles, and will require whole chapters of our text-books to be rewritten. The explanation of this change in the elastic limit is found in what Mr. Estrada referred to in connection with the conservation of energy. If a piece of metal is strained in such a way that no portion of the applied energy is converted into heat, then, upon release, that stored-up energy will restore the piece to its original length. But, if any portion of that energy has been converted into heat, the diminished energy will not restore the piece to

its original length, and it receives a permanent set proportional to the amount of energy lost; and, whatever change of conditions tends to change the amount of energy so lost, will change the elastic limit.

Prof. J. B. Johnson.—The particular conclusion, both of the writer of the paper and of others, which I think is entirely unwarranted by the observations, and also quite contrary to all the observed facts, is that the elastic limit is much lower under impact loads than under static loads. Mr. Estrada says:

> The most important of all the features brought out by these experiments undoubtedly is that the elastic limit is a variable quantity depending upon the conditions under which the loads are applied. An examination of the results shows that in many cases a drop of 2 ft. was sufficient to obtain a permanent set, and it is likely that with more accurate means to measure the effect, a drop of 1 ft., and even less, would have been sufficient to have reached the elastic limit.

Without analyzing the problem at all, or explaining his processes, the author of the paper concludes, from this evidence, that the elastic limit of the material is reduced to almost zero. This conclusion is reinforced by Mr. Thomas H. Johnson, also, in his discussion, where, after reviewing the facts, he says:

> We have, therefore, in one case, an elastic limit of one-half to two-thirds the ultimate strength, and in the other case this limit dropping to about zero. The material is the same in both cases. The difference is wholly in the mode of applying the load. We can, therefore, no longer regard the elastic limit as a property of the material, but as a function of the conditions of the test. This is directly at variance with accepted principles, and will require whole chapters of our text-books to be rewritten.

Both of these gentlemen then proceed to explain this new discovery on the principle of the conservation of energy.

To a superficial reader the charge that our accepted theories are wrong has been firmly established. In fact, they have not been in the smallest degree affected by these tests. The energy, or vis viva, of a weight of 100 lbs. falling 1 ft. is 1,200 in.-lbs. Now, the ultimate resistance to stretching of a ⅝-in. round rod at its elastic limit is about 10,000 to 11,000 lbs. The total distortion of an 8-in. iron or steel rod at its elastic limit of, say, 36,000 lbs. per sq. in., is $\frac{36{,}000}{28{,}000{,}000}$ of its length, or, say, one 1-100 in. The total work of resistance which this rod could offer to a shock, in tension, at its elastic limit, would be ½ (11,000 × 0.01) = 55 in.-lbs.

If all the energy of the falling weight of 100 lbs. were to be absorbed by the specimen, a drop of 55-100 of 1 in. would develop in the bar a stress of 11,000 lbs., and, therefore, bring it to its elastic limit. A drop of 1 in. would give it a permanent set, and a drop of 1 or 2 ft. would give it a large permanent set. The reason why the first drop of 2 ft. did not always give to these specimens a large permanent set was because there was so much resilience, or spring, in the parts intervening between the hammer and the specimen, and between the specimen and the ground. Here were the deflections of three cross-heads, the distortion of four rods, and the elastic cushion of the machine itself, which rested on a timber base, and we know not how much more elastic matter below the timber, all of which were helping out the test specimen to absorb the energy of the blow. How much the specimen really had to take no man can tell, but evidently a very small portion, since a drop of 2 ft (2,400 in.-lbs.) never seemed to produce an appreciable permanent set, whereas the most the specimen could absorb, without permanent set, was but 55 in.-lbs. It is patent, therefore, that the author of this paper has entirely overlooked the real elastic resilience of the bar itself, and has jumped to the conclusion that because it was smaller than he supposed, the elastic limit must be very low. In other words, if he had analyzed the problem, as all the "text-books" indicate, he would have seen at once that;

(1) The energy of his 100-lb. weight was mostly absorbed by something else than the specimen itself, and that the portion taken by the specimen was entirely unknown.

(2) That this is an inherent weakness of all impact tests.

(3) That the elastic portion of the total resilience of every blow is not permanently lost by the specimen, but may be used over and over an infinite number of times, and hence it is included in the "total foot-pounds of energy resisted" as many times over as there were blows, and that, therefore, this total is misleading.

(4) That the total energy that any kind of engineering material can absorb without taking a permanent set is very small indeed.

(5) That not knowing what portion of the total energy of any blow is taken by the specimen itself, and what portion is taken by the accompanying parts, including the foundation, we could never compute from an impact test the stress per square inch produced in the specimen, even when this was known to be within the elastic limit.

(6) That the only surprising thing about these particular tests was that the first blow (of 2 ft. fall) should produce so small a permanent set in the length of the specimen, since to produce no appreciable set implied that 95% of this energy had been absorbed by the accompanying parts and only 5% by the specimen itself, even for a 36,000-lb. per sq. in. fiber stress.

As to the other "discovery" of the paper—that impact tests or instantaneous loading gave greater elongations—this was fully established by Colonel Maitland in a paper before the Institute of Civil Engineers on "The Treatment of Gun Steel." An apparatus similar to Mr. Estrada's was used, and also gunpowder explosions between two cylinder heads joined together by rods, and the elongation was raised from 27% for the static tests to 47% for the blows and to 60% for the explosions. This action of suddenly-applied loads is also given by Professor Unwin, in his "Testing of Materials of Construction." In no other place have I found any statement at all as to the effects of instantaneous loads.

As between quick and slow static tests, Professor Bauschinger has shown conclusively that between any reasonable limits, as from one minute to one hour, there is little or no difference in the results, possibly a somewhat smaller elongation and greater strength on the longer test, but the differences are not appreciable. Since a large part of the elongation of a short specimen in a static test results from the stretch of the necked-down portion, and since this is a species of flow requiring time for its operation, an instantaneous pulling out of a bar stretches all parts to this same ultimate distortion, the time-resistance being so much greater than the effect of any local weakness. There is little doubt that the actual stress developed in the bar, when stretched suddenly, is much greater than it could possibly exert under a static load.

We have discussed the questions raised by the above paper and discussion in our editorial columns.

THE STRUCTURAL MOTION THEORY OF BRIDGE STRESSES.*

The existence of "motion" in bridges is palpable. "Structural motion" (the "motion" induced in structures by the live load) is rhythmic and persistent and cumulative. A structure with excess of "motion" is one of limited existence, and this excess of "motion" may be present in structures that are up to fair statical standard. On the other hand, a structure may be below a fair statical standard and be free of "motion," with consequent ability to withstand the work of prolonged service despite its deficiencies.

Motion in structures can be distributed, controlled and directed, its rhythm broken, its persistence met; and this can be done rationally and practically, so that a modern bridge free of "structural motion" may cost no more than one of current design, while its maintenance will cost much less.

At present a typical trainload imposed statically with no definite regard for the number of impositions of load is the ultimate criterion of the service over bridges, although a flat wheel in a coal car may induce more stress and "structural motion" than the heaviest engines. The "structural motion" induced by the cars of a train, taken in the aggregate, often demands more bridge resistance than the passage of the engine. More regard, therefore, should be had to "live load tonnage" than to typical engines and trains, as this engages the bridge often, and each train subjects certain members to stresses many times repeated, all of which tax the resistance of the bridge, more or less, correspondent to the magnitude of the stresses, plus the effects of persistence, rhythm, cumulation, etc.

Taking an example to illustrate the above: Given a tension web member of a truss with an original length equal to say L; when the bridge is thrown from its falsework, L increases in length to, say, L', which is hereafter, under favorable circumstances, its permanent length when at rest. Placing now a typical engine and train on the bridge the member for a very short interval of time will lengthen from L' to (say) L' + 10 y due to engines, and will then shorten to (say) L' + 7 y during the passage of the train, and then, when the train has passed off of bridge, it will return to its permanent length = L'. It will be observed that the amount of metallic lineal disturbance is 10 y for lengthening and (3 y + 7 y) = 10 y for shortening, of which 10 y persists, say, one second and 7 y persists, say, one minute, and 3 y persists, say, one second; or the total quantitive lineal disturbance equals (10 y + 7 y + 3 y) = 20 y, and the total quantity of disturbances considered numerically equals three.

This is not the true statement of the disturbance induced in the bar by the passage of an actual train, as the approach and imposition of the engine will probably find 11 y as the elongation of the member; this will be followed by 40 cars which, if at rest, would induce 7 y, but being a rolling load will vary with each car from (say) 6 y to 8 y, or 2 y for each car, and if the calculation is followed out it will show a numerical disturbance of 81 as compared with three for the typical load. This is a rough illustration considering one member only, and this outside of the aggravated effects of persistence and rhythm of induced "motion."

In many structures the change from 6 y to 8 y is very irregular and more often repeated than illustrated here, so that stresses far exceeding those allotted to a member are usually found to obtain, due to "structural motion" induced by the rolling load; and this excess of stress is manifest by the excess of elongation, etc. When a member shows under stress an extension of twice that computed, an illative proposition finds valid grounds (towards conclusive evidence) that the stress is twice that computed.

Respecting the basis of statics, modern concepts recognize the media through which stress manifests itself as inelastic to obtain true relations of stress. If the media are elastic, statics will not hold, and forces are equal to each other only when they produce equal effects. Thus if a train produces at rest one resulting quantity of stress, and another and larger quantity when moving, statics alone can no longer be the absolute criterion of design. Statics will furnish a preliminary criterion, however, and "structural motion" concepts reduced to rational methods will furnish a final criterion for advanced design.

It can be shown that bridges can be constructed designed under the "structural motion" theory that will gage throughout under trains, almost the same as though the loading were imposed statically. "Motion" is met first by mass, which here can be translated weight. Given two bridges of like panels, sections, spans, etc., the bridge which has (within limitations) the more weight is better able to resist the effects of the persistence of "motion." "Motion" is secondly met and controlled by the system of truss panelling adopted. In any bridge, the "motion" induced is a matter of live load; if the sections are made up more with reference to live, than to dead load, resulting freedom of "motion" will obtain.

The effect of "motion" in structures cannot be discarded in future designs. The general use of steel for structures, much of which is poorly adapted to withstand the effects of "motion," demands recognition and consideration of "structural motion;" for though much of this material is well adapted to withstand stress purely statical, it is not able to withstand permanently the molecular disturbance induced by "motion;" all that can be done is to reduce to a minimum the quantity of "motion" as much as practicable.

A bridge heavy with its own structural material may indeed be free of "motion," but a bridge of less material, with mass in the shape of ballast and old rails at $7 per ton is cheaper. Bridges at minimum cost with timber floors, eventually to be replaced by old rail floors, can be built at low cost, and with the growth of traffic (increased number of trains and heavier engines, etc.) can be floored with old rails, the cross-ties bedded in ballast, and a modern structure of permanence result, with a structural resistance over and above that which current practice is now furnishing to most railways.

* Abstract of a paper by Geo. H. Thomson, M. Am. Soc. C. E., in the "Railway Review."

THE REMOVAL OF CORROSION FROM WATER MAINS.*

By Herbert Henderson, Assoc. M. Inst. C. E.

The idea of utilizing the pressure in the mains to drive scraping machines originated with, and the apparatus was invented by, the late Mr. J. G. Appold, M. Inst. C. E. In 1873 Mr. Thomas Kennedy, the managing director of the Glenfield Co., Kilmarnock, Scotland, devised a modification of the Appold scraper, and this has been in general use up to the present time. Experience has shown that the type of machine most suitable for mains ranging in diameter

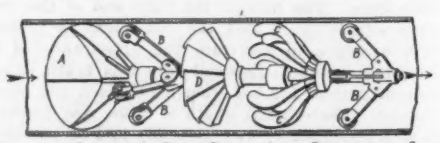


Fig. 1. Scraper for Removing Corrosion from 8-in. Pipe.

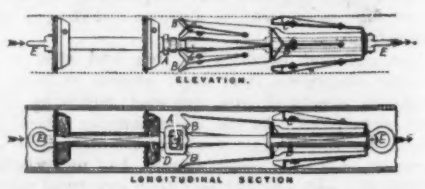


Fig. 2. Scraper for Removing Corrosion from 36-in. Pipe.

* Abstract of a paper in Proc. Inst. C.E., Vol. CXVI., session 1893-'94.

from 6 to 18 ins., is that illustrated in Fig. 1. It consists of two distinct portions connected by a swivel joint, A; the front carrying the steel scrapers, and the rear the wrought iron or steel propelling pistons. Leather disks, intersected by radial cuts and stiffened at the back by lead plates, are placed behind each piston. The springs, B, with steel scraping edges, C, are arranged in two sets of four each, the set behind breaking joint with that in front.

For larger sizes of mains, the type employed is that shown in Fig. 2. The weight is carried by the curved steel springs, F, one set at each end of the machine. The construction of the pistons, leather disks and the connection between the front and rear portions, are similar to that of the smaller machine. The scraping knives are fixed to rocking brackets, H, pivoted to disks, L, attached to the center rod, and are forced against the interior surface of the pipe by spiral springs, J, which are fixed at one end of the brackets, K, carried by the same disks, L. The hatch boxes, by means of which the scrapers are introduced into the mains, are placed as far apart as possible, consistent with efficiency. After they are fixed, a brick chamber should be built around them, with a drain of sufficient size to carry away the effluent water during operation. As a provision for the future, hatch boxes are put into the mains in many new works in progress, thus saving expense hereafter.

The actual operation of pipe scraping has been described to Mr. James Mansergh,* M. Inst. C. E., and Mr. M. B. Jamieson.** As they differ but slightly in detail, repetition here is unnecessary; but it may be of interest to give a brief outline of the method of working. After inserting the machine, and before turning on the water to start it, a few men are posted on the line of main, about 150 yards apart, with instructions to take up, each in turn, similar positions beyond the last man as soon as the machine has passed him; and, in order to keep the apparatus under control, a code of signals is arranged, so that the man in charge of the valve commanding the main may know when to open or close it. The person in charge ought always to be as directly over the machine as possible. The low rumbling noise made by it when in motion is easily distinguished; and when it is stopped, the sound of the water rushing past it enables its position to be determined, If it stops and does not show any sign of moving after a reasonable time has elapsed, such expedients as shutting the water off and turning it on again suddenly, inserting a loosely rolled wisp of hay in the main behind it,or,If the latter is exposed,rapping it smartly with a hammer around and over the machine, should be tried. If these fail to restart the scraper, the pipe must be cut in front of it and the obstruction removed. The author has known the machine to stop for an hour, until the corrosion accumulated in front of it has been washed away, when it has restarted. From the accompanying table, which gives a summary of the cost of scraping water mains, it will be seen that the obstructions, other than corrosion, found in mains are of a varied description, and are only to be accounted for by carelessness in laying.

In America, a rotary machine, a sketch of which is given in Fig. 3, is much used with good effect for cleaning oil mains. The author is not, however, aware whether this type of scraper has been tried in a water main.***

Summary of Cost of Scraping Water Mains.

Year.	Place.	Main. Size, ins.	Main. Length, ft.	Cost manholes and cleaning. Total, $.	Cost manholes and cleaning. Per ft., cts.	Obstructions removed other than corrosion.	Gain delivery, per cent.
1877	Owestry	7	5,720	589	2.1	Large stones, lead and defective pipe	54.4
		6	21,780				
			27,500				
1878	Lancaster	8	6,780	146	2.2	Peaty matter	56.1
1880	Durham	12	5,866	443	7.5	Lead, spade, hand-spike and wagon sprag	
1880	Bradford	18	22,220	3,088	13.9	Stones, lead, crowbar, etc	55.6
1881	Halifax, N. S	12	5,853	443	7.5		
1882	Exeter	10	10,560	935	8.9		
		12	10,560				
			21 120				
1883 1885	Whitehaven	13	11,616	2,513	7.5	Mussels, stones, lead	27.6
		11	17,072				
			33,688				
1885	Birstal	6	6,065	170	2.8	Stones.	
1886	Denbigh	6	6.160	731	1.2	Stones, gravel, lead.	
1887	Omagh	6	11,352	248	2.2	Lead, defective cast ngs	300.0
1887	Halifax	6	776	102	13.1		
1887	Roubaix	24	22,282	2,069	9.3	Calcareous matter.	
1888	Ulverston	6	5,280	351	6.6		
1890	Dundee	15	10,560*	1,237*	....	Wood, stones.	
1890	Dumfries	9	5,280	537	2.0	Stones.	
		8	21,120				
			26,400				
1890	Scarborough	8	5,800	302	5.2		
1891	Newport	10	1,080	244	2.3	Lead.	
1891	Lanark	7	32,560	365	1.1	Lead, wood, stones	33.7
1891	Guisboro	6	5,280	175	3.3		
1891	Newport	5	75†	37	49.3		

* Only half of cleaning completed, but manholes for whole length are included in cost.
† High pressure hydraulic main

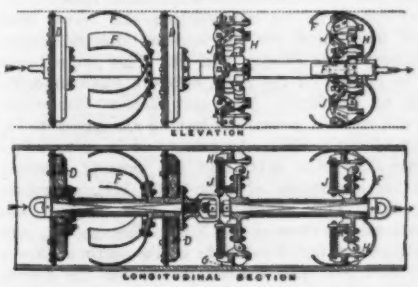


Fig. 3. Rotary Scraper Used for Cleaning Oil Mains.

* Proc. Inst. C. E., Vol. LXVIII., p. 258.
** Proc. Inst. C. E., CXVIII., p. 323.

*** A detailed account of the use of a pipe scraper to remove incrustations from the water mains of Halifax, N. S., written by Mr. E. H. Keating, M. Am. Soc. C. E., is given in Trans. Am. Soc. C. E., Vol. XI., pp. 127-45 (April, 1882). A brief abstract of the paper was given in Eng. News, March 18, 1882.

THE COLORADO RIVER DAM AT AUSTIN, TEX.

By Frank E. Snyder.

This dam is situated in Travis Co., Tex., 3½ miles northwest from the business portion of the city of Austin, the state capital. The dam spans the Colorado River, the river reaching above this point about 400 miles into northwestern Texas and having a drainage area of between 40,000 and 50,000 square miles.

The dimensions of the dam are as follows:

	Feet.
Length of rollway	1,090
Length of bulkheads and headgates	270
Total length over all	1,360
Width at base	66
Height above low water	60
Total height above foundation	68
Sectional area above low water, sq. ft.	1,817

The dam has been constructed for the purpose of furnishing power for a water supply and electric lighting system for the city of Austin and a reserve power for manufacturing industries. A preliminary survey and report on the work was made by Mr. Jos. P. Frizell, M. Am. Soc. C. E., of Boston, Mass., in March, 1890, supplemented by a report on the same by Mr. John Bogart, M. Am. Soc. C. E., State Engineer of New York. Both reports being favorable, plans were at once ordered and contracts let, Mr. Frizell having previously been chosen Chief Engineer of the Board of Public Works.

The contract was let for the dam proper and excavation for the power house site on Oct. 15, 1890. Work was immediately begun. The first masonry was laid May 5, 1891. The last stone was set in the dam May 2, 1893.

The details of construction were presented in Engineering News of Jan. 26, 1893, the most notable part of which was the operation of a Lidgerwood overhead cableway, by means of which the blocks of stone were hoisted from the cars, carried and lowered directly into position in the dam. The dam was built with granite faces and a core of rubble limestone masonry. Granite was brought from 60 miles distant, limestone from about 1,200 ft. from the dam. The granite was laid in 3-ft. courses. The work consisted of the following:

	Cu. yds.
Earth excavation	108,262
Rock excavation from site of dam	2,280
Rock excavation from site of power house	27,860
Concrete masonry	331
Rubble limestone masonry	70,651
Granite masonry	20,648

The dam was imbedded in solid rock throughout, the rock being medium grade limestone. The prices for the different classes of work were as follows:

	Per cu. yd.
Earth excavation above low water	$0.14
Earth excavation below low water (about 20% of total earth excavation)	0.50
Rock excavation from site of dam	1.60
" " " " " power house	0.80
Concrete masonry	6.00
Rubble limestone masonry	3.50
Granite masonry in upstream face	11.00
" " " downstream face	11.25
" " " corbel course	12.75
" " " coping	18.50
All granite and rubble masonry was laid in Portland cement mortar, for which was paid extra in addition to above prices	0.50
Pumping, bailing and draining (total)	8,000.00
Total cost of dam, including extras	$611,313.00

The dam as completed, with the corbels for supporting a 24-in. water-main, is shown in cross-section by Fig. 1, and the completed structure at the June rise of this year by the view, Fig. 2, which is referred to near the close of this article.

Water will be taken to the turbines through iron penstocks set in head-gate masonry at the east end of the dam, the power house to be built immediately below the head gates. The head-gate masonry is built with granite facing and a limestone rubble masonry backing similar to the dam. It extends from the east end of the dam a distance of 108 ft., and is carried up 16 ft. above the crest of the dam to provide against floods, it being estimated that in times of great floods the dam will have to pass a depth of 14 ft. on its crest.

There are seven penstocks, 9 ft. in diameter. Four of these will be used by the city of Austin for operating the water supply and electric lighting machinery, the other three to be held as a reserve power for manufacturing plants.

The penstocks, head gate castings and racks were let in one contract, the prices being as follows:

	Per ton.
Rock bars, frames and bolts, in place	$93.80
Headgate castings and bolts, in place	95.00
Penstock, branch and feeder pipework, in place	97.55
Balance valves in 5½-ft. feeder pipe (each)	770.00

This makes the cost of a 9-ft. penstock something over $14 per lin. ft.

The power plant consists of two vertical turbines of 185 HP. each, for operating the pumps, and four pairs of horizontal turbines of 506 HP. per pair for operating the electric plant. The wheels will work under a head of 54 ft. These turbines, with two 4,000,000-gallon water power pumps to work against 265 ft. head, were let in one contract and will cost in place $37,580. The power plant is being built from the plans of Mr. J. T. Fanning, M. Am. Soc. C. E., Consulting Engineer to the Board of Public Works.

Just after the completion of the head-gate masonry, in May, 1893, a break occurred in the eastern bank of the river, covering about an acre, extending both above and below the head-gates and including part of the power house site. Some 30 ft. of the eastern end of the masonry was broken off and carried down, at the end, about 2 ft.; also the foundation wall for the river side of the power house, extending directly south from the east end of the dam, was toppled over. A cofferdam was thrown across from the end of the dam, northeast to the bank, about 80 ft. distant, and this masonry then taken out and rebuilt. It was found that the break was due to a fault in the limestone formation, the original stratum built upon having been a shelf about 20 ft. thick resting upon a soft stratum from 4 to 8 ft. thick, which was washed out by the pressure with the lake full. This stratum was at elevation + 21. The head-gate masonry was all taken out with the exception of the part enclosing the

two penstocks next the dam. The excavation was carried down below the soft formation some distance, then a tunnel driven through this stratum back under the standing head-gate masonry to the end of the dam and refilled with masonry. The head-gates were then built up to the former level and a cut-off wall extended from the eastern end of the new masonry into the bank a distance of 140 ft. to prevent water seeking entrance around the

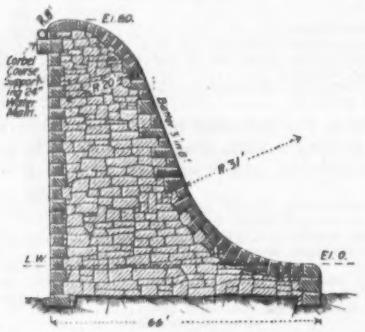


Fig. 1. Cross Section of Dam Across Colorado River at Austin, Texas.

end and further damaging the power house site. This work was completed in March, 1894; contracts have been let for rebuilding the power house foundations. Delay had been occasioned in the work by a stratum at elevation — 10, which was cut into in sinking for a base for the wall overturned by the break. Examinations were made recently by Mr. E. H. Kellogg, of Denver, with Mr. Jos. Kepferle, Engineer of the Board. It was reported that this was a water-bearing stratum running at about right angles to the dam, about 2 ft. thick next the river wall line and running out about 20 ft. to the east; that this could best be handled by trenching into it laterally, just below the head-gates, and filling with a wall, when the excavation for the river wall could be sunk as first planned. This water being pure and clear is to be utilized through an 18-in. pipe set vertically into this stratum just north of this cut-off wall. This work is now going forward under the direction of Engineer Kepferle.

The cost of replacing the head-gate masonry and power house wall overturned by "the break" will be about $64,500.

The highest rise since the completion of the dam was 4.5 ft. over the crest. A rise of 3.7 ft. occurred June 3, 1894, the photograph from which the accompanying view. Fig. 2 was made having been taken at that time. The height of back water during this rise was + 12.3 ft.

The lake formed by the dam is 26 miles long, and has an area of 2,000 acres.

The total cost of the improvements in connection with the dam is estimated to reach $1,400,000 upon completion. This will include, in addition to the dam and power house work, a complete waterworks system comprising about 40 miles of mains, an electric plant installed sufficient to furnish electrical power for all commercial and lighting purposes for the entire city, and a railway and boulevard 3¾ miles long from the dam to the city.

THE NEW YORK GARBAGE DEODORIZING PLANT AT RIKER'S ISLAND.

A permanent plant for treating the garbage and other refuse collected by the Street Cleaning Department of the city of New York is now being put up at Riker's Island, in the East River, by the Woolf Electric Disinfecting Co., of 66 Broad St., New York. This plant is designed to manufacture sodium hypochlorite by means of electrolysis, as noted editorially in our last issue. The solution is to be sprayed upon the refuse as it is spread upon the dump, for the purpose of deodorizing it and preventing, as far as may be, subsequent offensive putrefaction. The plant will have a capacity of 4,000 gallons per hour, or 96,000 gallons per day, and will include two 100-HP. horizontal boilers, two 60-HP. engines, four dynamos of 1,000 amperes and 12 volts, six 500-gallon electrolyzing tanks, one 3,000-gallon supply tank for receiving, and the necessary pumps for lifting the sea water prior to its treatment, and also pumps for distributing the so-called electrozone after its manufacture. There will be a coal shed, a 25 × 35-ft. boiler room and a 25 × 100-ft. room for the engines, dynamos and other appurtenances. The building will be of wood, one story high, erected on the edge of the cribwork built to confine the dump. About 11,000 ft. of 4-in. wrought iron pipe, with short branches and gates, from 100 to 200 ft. apart, has been laid along the edge of the cribwork and a temporary plant has been distributing electrozone since June 28 through hose attached to the branches and to each end of the main pipe. In this manner the whole dump, said to be about one mile long and from 100 to 200 ft. or more wide, has been drenched with sodium hypochlorite. The liquid has penetrated the mass of refuse, a mass which almost defies description, so varied is its composition, to a considerable depth, and, it is alleged, has so deodorized it as to practically do away with the far-reaching odors which disturbed the olfactory nerves and well nigh upset the mental balance of the people of the annexed districts of the city and of a part of Long Island. On July 27, after the temporary plant had been in operation some four weeks, a member of the staff of this journal visited the island at high tide and found everything in an apparently satisfactory condition. How it had been prior to the use of the electrozone cannot be stated from personal observation, but on the day named only a slight odor was noticed on approaching the island, which may have come from an excavation just then being made for the engine foundations of the permanent plant. On walking over the dump practically no odor could be detected and on digging into it from 6 to 24 ins. only a musty smell or a slight odor resembling that from a well "steamed" pile of horse manure could be discerned. Much of the matter thrown up, in so far as it was not ashes or other inorganic matter, had a charred appearance, as is often shown by the straw of a dung heap. As has been stated, the tide was high at this time. At low tide refuse is exposed which has had incomplete treatment and is more liable to give off an odor, but this is gradually receiving treatment. It is stated that when the electrozone was first applied, the refuse was steaming in places from the fermentation going on in the mass. This fermentation had undoubtedly burnt out much of the organic matter in the refuse, which had been accumulating since last December, and doubtless accounts for a good part, if not of all, of the charred appearance noted above. As to the efficiency of the treatment, an opinion cannot well be given by one not familiar with the dump before as well as after treatment, and no information is at hand regarding the expense involved, save that $37,000 was appropriated to cover the cost of the permanent plant.

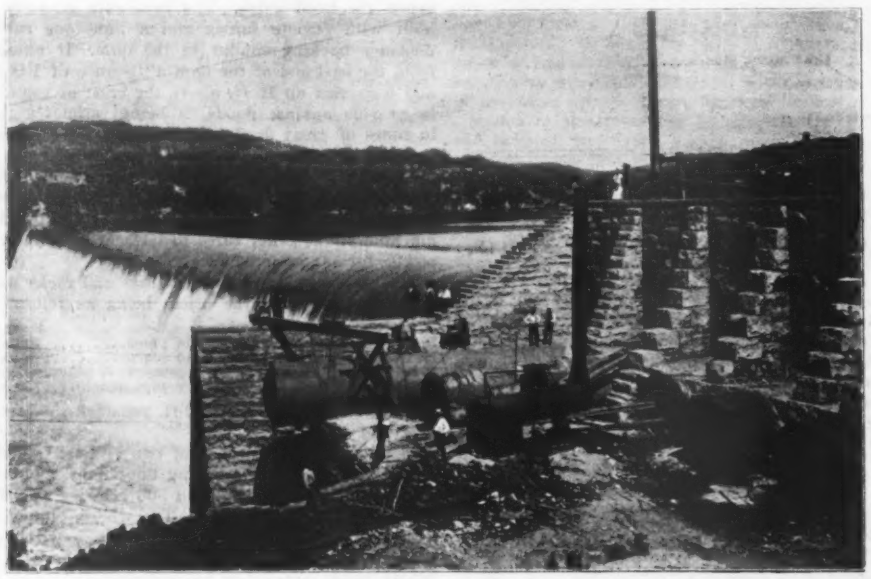


FIG. 2. VIEW OF AUSTIN DAM, LOOKING NORTHWEST.
3·7 ft. of Water on Crest, June 3, 1894.

NEW ELECTRIC TROLLEY LINES IN CHICAGO.

About 100 miles of double-track horse railway on the west side and north side of the river in Chicago are to be changed to electric trolley lines, if the present plans of the West Chicago and North Chicago Street Railway companies are carried out. The West Chicago Co. has already made application to the Department of Public Works of the city of Chicago for permission to begin work on its Van Buren St. line, and contracts are being let for the power houses and generating machinery of both this and the North Chicago company.

The power station of the West Chicago company is to be located at Washington Boulevard and Western Ave., where the present stables and repair shops are located. This point is particularly well suited for a power station, as it is about the center of the system of lines which will be operated from it. When completed the West Side station will contain five 2,000 HP. and one 1,000 HP. generators, giving it a total capacity of 11,000 HP., capable of moving 500 cars. At present, however, only three of the 2,000 HP. and the one 1,000 HP. generators are to be built. According to the terms of the contract, the first generator is to be completed in four months from the date of the contract and an additional machine every fifteen days.

The West Side power station is intended to operate lines on 60 miles of streets, or 120 miles of single-track road, all of which will have to be changed from horse to electric power. Work will begin immediately on the Van Buren St. line, which will have to be entirely rebuilt. It is stated that arrangements will be made to connect the electric cars on this line with the Halsted St. cable cars.

The contracts for constructing the North Side power house and for the engines and generating machinery have already been let. This power house will be located on the river, opposite Sharpshooters' Park, at California Ave. and Roscoe Boulevard, and will contain generators having an aggregate capacity of 6,000 HP. At present it is intended to operate 135 cars only, and the present contract calls for generators of only 2,800 HP. aggregate capacity. The generators in this station will operate all the lines of the North Chicago Co., and such lines on the West Side as lie north of North Ave., and will also furnish power for the Elston Ave. line of the Chicago Electric Transit Co. This company was chartered some two years ago, and is ostensibly an independent corporation. It is reported, however, that the West Chicago company will ultimately absorb its lines.

The entire electrical plants of the two companies embrace double tracks on 100 miles of street. It is expected that the first electric cars will be in operation early next year, and others will be rapidly equipped after that. The cross-town lines can be got ready to operate by electricity rapidly, for they will not have to be rebuilt. All lines laid within the last year or two have been put down with the intention of changing them from horse to electric power, and nothing will be necessary but to string the trolley wires.

PERSONALS.

Mr. T. Howard Barnes has been appointed City Engineer of Medford, Mass.

Mr. John C. Moulton, who was for many years head of the Laconia Car Co., died at Laconia, N. H., July 26, at the age of 83.

Mr. Thos. M. Sayre, Superintendent of the Consolidated Traction Co., died at his home in Jersey City, July 30, at the age of 50.

Mr. C. E. Dearborn has been appointed Chief Engineer of the Calumet & Blue Island Ry., with headquarters at South Chicago, Ill.

Mr. Austin L. Fassett, of White Plains, N. Y., has resigned his position as Superintendent of the Westchester County Water-Works Co.

Mr. Theodore Perenot, the engineer who designed the caisson system of jetties employed at Aransas Pass, died at San Antonio, Tex., July 21.

Mr. J. W. Wardwell, General Superintendent of the Cleveland, Canton & Southern Ry., has been appointed Receiver of the road, vice Mr. Frederick Swift, resigned.

Mr. Edward McKenna, Assistant General Superintendent of the Chicago, Milwaukee & St. Paul Ry., has accepted the position of General Superintendent of the Great Northern Ry.

Mr. Frank J. McCain, formerly of the F. J. McCain Co., has been elected Vice-President and General Manager of the Griffith & McDermott Construction Co., of Chicago, with headquarters at Willow Springs, Ill.

Mr. Theodore E. Knowlton, Engineer of Signals on the Mohawk Division of the New York Central R. R., with headquarters in Utica, has taken a position on the Rome, Watertown & Ogdensburg Ry., and has been succeeded by Mr. Clifford Lewis.

Mr. P. E. Burwell, General Superintendent of the Cumberland & Pennsylvania Ry., has resigned his position, but will remain with the company as Consulting Engineer. Mr. Lewis Hamilton, his assistant, has been appointed General Superintendent.

Mr. Loyall A. Osborne has resigned his position as Chief Electrician of the Newark works of the Westinghouse Electric & Mfg. Co., to engage in private practice as a consulting electrical engineer, with headquarters in the Prudential Building, Newark, N. J.

Mr. Mordecai W. Jackson, who founded the Jackson & Woodin Mfg. Co., 60 years ago, died at Berwick, Pa., July 18, at the age of 82. The company began with a small plow foundry, and now has works covering over 70 acres for the manufacture of cars, car material, etc.

Mr. Justus M. Hogeland, Assistant Engineer on the Brainerd & Northern Minnesota Ry., now under construction, died at Brainerd, Minn., July 27. He was 22 years of age, and commenced his engineering work as a rodman at the age of 15. He had been Assistant Engineer on the Pacific extension of the Great Northern Ry.

Mr. James P. Nelson, Professor of Civil Engineering in the State College of Kentucky, and formerly Chief Engineer of the Eastern Division of the Newport News & Mississippi Valley Ry., and Mr. W. R. Wallis, have associated themselves together under the firm name of Nelson & Wallis, with office at Lexington, Ky., to practice as consulting and contracting engineers.

Mr. T. Hackworth Young, formerly assistant to the Chief of the Transportation Department at the Columbian Exposition, and who recently resigned his position as Master Mechanic of the Mexican Central Ry., died at Sacramento, Cal., July 21. He was a grandson of Timothy Hackworth, the English mechanical engineer whose name is so well known in connection with early locomotives.

Mr. L. H. Clarke has been appointed engineer in charge of track elevation of the Lake Shore & Michigan Southern, and the Chicago, Rock Island & Pacific railways, with headquarters in the Van Buren St. station, Chicago. Mr. Clarke was connected with the engineering department of the Illinois Central R. R. for 18 years, was later Chief Engineer for the Lake Shore & Michigan Southern Ry. for ten years, and has, until recently, been City Engineer of Chicago.

Col. Addison G. Mason, Division Superintendent of the Lehigh Valley Coal Co., was killed; and Prof. Joseph Burrell, Instructor in Mathematics at Lehigh University, and Mr. Robert S. Mercur, Assistant Division Engineer of the coal company, were injured in the old "Knight Shaft" of the company's mine at West Pittston, Pa., July 26. They had been inspecting some work for reopening the mine and were ascending in the cage when it got stuck in the guides, and the strain on the hoisting rope tore away the upper part of the cage, the lower part falling down the shaft with the three men named and the mine foreman, who also was killed.

Mr. Edgar A. Van Horn, who died at Oswego, N. Y., July 31, was formerly connected with railway service. In 1872 he became Superintendent of the Lake Ontario Shore Ry., now the Western Division of the Rome, Watertown, & Ogdensburg Ry. In September, 1878, the former road was consolidated with the Rome, Watertown & Ogdensburg Ry. Mr. Van Horn was made General Manager. He resigned in 1883 to take a position as General Manager of the Utica & Black River Ry., with headquarters at Utica. He resigned the latter position because of poor health, and has since been engaged in the hardware business in Oswego.

Mr. Henry Yates, M. Inst. M. E., M. Can. Soc. C. E., died at Brantford, Ont., July 26, at the age of 73. He was born at Walton-le-Dale, England, and was apprenticed to the firm of Nasmyth & Gaskill, of the Bridgewater Foundry, by which he was sent to France on works for the Paris and Rouen Railway. In 1846 he returned to England and entered the locomotive department of the London & Southwestern Ry. where he remained until 1853, when he was engaged by Mr. C. J. Brydges, Managing Director of the Great Western Ry. of Canada. He settled at Brantford several years ago and was twice elected alderman. He leaves a widow and three sons; one of the sons being an engineer, and another a contractor.

Mr. Thomas Jefferson Hill died at Providence, R. I., July 24, at the age of 89. He was born at Pawtucket in March, 1805, and was early employed in the mills and machine shops. He and Mr. S. Slater organized the Providence Machine Co. in 1832, and in 1846 he became sole proprietor. Since then he has been interested in several manufacturing and machine works. The Providence Dredging Co. was organized by him in 1866, and a year later he organized the Rhode Island Malleable Iron Works, and in 1874 the Providence Pile Driving & Bridge Co. was established by him. Subsequently he founded the village of Hill's Grove, on the New York, New Haven & Hartford R. R., and in 1875 he started a large cotton mill there.

Mr. A. M. Van Auken, a civil engineer and railway promoter of Chicago, has mysteriously disappeared, and according to newspaper reports a number of people are engaged in an unsuccessful search for him. He was formerly located in Denver, being at one time on the engineering staff of the Denver & Rio Grande, and later a partner in an engineering firm. He removed to Chicago when work began on the drainage canal and secured a position there, but soon left it to engage in more extensive operations. According to newspaper reports, he was president of the Interstate Investment & Improvement Co., of Chicago, a concern which was engaged in promoting the construction of some 300 miles of railway. Under the name of the Peoria, Springfield & St. Louis Ry. it was proposed to build extensions of the Indiana, Bloomington & Western, the Quincy, Missouri & Kansas City, and the Omaha & St. Louis railways. On June 15, Mr. Van Auken came to New York to secure capital for the enterprise, stopping at the St. Denis Hotel, and left there, ostensibly for Chicago, on July 6, since which time nothing has been heard from him. He is said to have rented an entire floor of the Omaha Building in Chicago, and of the Manhattan Trust Building in New York city, and to have engaged the services of over a hundred persons for his schemes, to begin work on July 1. According to press reports, he borrowed money in New York, which he left without paying, and he is said to have been indicted for forgery at Quincy, Ill., in 1890. It is seldom indeed that we have to publish such a record of an engineer, but we deem it our duty in this case, as we have personal knowledge of his long continued failure to pay debts, and the notice may save some of our readers from loss through him.

NEW PUBLICATIONS.

ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—Ninth Annual Report. Being the Proceedings of the Ninth Annual Meeting, held at Champaign, Ill., Jan. 24, 25 and 26, 1894. Secretary, Jacob A. Harman, Peoria, Ill. 8vo; pp. 119; price, 50 cts.

In addition to the minutes of the proceedings, which were reported in our issue of Feb. 1, there are the address of the president; and the reports of committees on engineering, cost of work, examination and licensing of land surveyors, land drainage and public highways, and mining engineering and economic resources of Illinois. There are also the following papers: "Cost of Work," Edwin A. Hill; "Experience with Creeping Rails," W. D. Pence; "Cribs and Retaining Walls," E. M. Benson; "Foundations of the Granite Viaduct, N. P. R. R.," E. I. Cantine; "Bridge Erection," W. F. Kendall; "South America and Young Engineers," Peter Morgensen; "Methods of Driving Stakes," J. W. Alvord; "Elevating the Standard of the Surveying Profession," S. Rudolph; "Paving Operations at Rock Island," W. A. Darling; "Macadamized Public Roads," Arthur Lagron; "Determination of the Amount of Storm Water," A. N. Talbot; "Sewerage," T. S. McClanahan; "Seap Drainage," M. J. Howard; "Water Powers on Large Rivers," Daniel Gordon; "Efficiency of Insensible Ventilation," J. M. White; "Present Status of the Metric System," S. S. Greeley; "Survey Problem," D. L. Brancher; "Drainage," G. P. Knight.

TRADE PUBLICATIONS.

BLASTING POWDER, ETC. Aetna Powder Co., Chicago, Ill. 8vo; pp. 47; illustrated.

This pamphlet contains particulars of the Aetna blasting powder and dynamite, with instructions as to the methods employed for various kinds of work, and directions as to the use of cartridges, fuse, firing batteries, etc.

SOCIETY PROCEEDINGS.

NEW ENGLAND ROADMASTERS' ASSOCIATION.—The annual meeting will be held at the American House, Boston, Mass., Aug. 15 and 16. The subjects to be discussed are as follows: 1. Labor on track; labor required under varying conditions, the amount of traffic and the season of the year being considered. 2. Snow plows and flangers; best method of keeping tracks clear of snow. 3. Guard rails, and guard rail distances. 4. Rail joints; improvements made and defects yet to be overcome. 5. Track tools, nut locks, spikes, bolts, rail braces and tie plates. 6. Review of previous year's discussions.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The regular summer meeting was held at Allegheny Springs, Va., July 14, with the president, Mr. C. S. Churchill, in the chair. The president delivered his annual address, setting forth the various occupations represented in the membership of the association and showing the influence exerted by these members in the development of the resources of the country. Attention was called to the progress that has been made during the last few years and the line of future development clearly marked out, the establishing of plants for the turning out of the finished products such as stove castings, structural iron and steel, steel plates and bars, etc., from our raw material, instead of sending it away to be finished elsewhere. Particular attention was called to the production of steel by the open hearth basic process, in which way the iron of this section can be advantageously treated. The by-products of manufacture were shown to be a large element in the profit of the manufacturer, and to the saving of which much attention was being given.

Mr. Staples described the construction of the canal connecting the head waters of the Mississippi with the head waters of the Illinois River, exhibiting at the same time a number of photographs of the work. The special feature of the work was the entire use of concrete masonry in the walls, locks, etc., which was put in at a cost averaging about $8 per cu. yd.

The address of Colonel Craighill before the American Society of Civil Engineers (Eng. News, June 28, 1894) was read before the association and brought out much discussion. That part relating to the construction and control of the Nicaragua Canal received special attention, and a resolution was passed instructing the secretary to communicate with the congressmen from Virginia, urging them to use their influence for the early construction and completion of the Nicaragua Canal and its ultimate control by the U. S. Government.

Mr. Dunlap read a paper on Municipal Improvements, outlining the various needs to be looked into and obstacles to be encountered in laying out and providing for the future of a new town. Mr. Wallis gave a talk on "How to Design a Paint," which was both interesting and instructive. The next meeting of the association will be determined by the directors and notice given in due time. John A. Pilcher, Secy.

COMING TECHNICAL MEETINGS.

WESTERN SOCIETY OF ENGINEERS.
Aug. 1. Secy., Thos. Appleton, Lakeside Bldg., Chicago.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Aug. 3. Secy., O. Von Geldern, 719 Market St., San Francisco.

ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Aug. 9. Secy., G. W. Shaw, Norton Building.

NORTHWEST RAILWAY CLUB.
Aug. 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Aug. 14. Secy., D. W. McMorris, Burke Blk., Seattle, Wash.

NEW ENGLAND ROADMASTERS' ASSOCIATION.
Aug. 15, 16. Boston, Mass. Secy., E. E. Stone, B. & A. R. R., Springfield, Mass.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Aug. 16. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

AMERICAN ASSOC. FOR THE ADVANCEMENT OF SCIENCE.
Aug. 16 to 23. Brooklyn, N. Y. Secy., W. Putnam, Boston.

AMERICAN FORESTRY ASSOCIATION.
Aug. 20 to 24. Brooklyn, N. Y. Secy., J. D. W. French, Boston, Mass.

SOCIETY PROMOTION OF ENGINEERING EDUCATION.
Aug. 20 to 23. Brooklyn, N. Y. Secy., Prof. J. B. Johnson, St. Louis, Mo.

ROADMASTERS' ASSOCIATION OF AMERICA.
Sept. 11, 12, 13. New York. Secy., W. W. Sharpe, Waycross, Ga.

ASSOC. SUPERINTENDENTS OF BRIDGES & BUILDINGS.
October. Kansas City, Mo. Secy., S. F. Patterson, Concord, N. H.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 2 to 6. Bridgeport, Conn. Secy., R. W. Raymond, New York.

AMERICAN SOCIETY OF RAILWAY SUPERINTENDENTS.
Oct. 20. New York. Secy., G. A. Hammond, Boston.

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AND

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Through an error in writing the titles on the proofs, the cut on page 69 of our last issue, inserted in the article entitled a "Solid Floor System, Front St. Viaduct, Columbus, Ohio," should have been inserted in the following article on the same page, describing the bridges at the new Providence Terminal Station. We reprint on another page of this issue, therefore, the article on the Columbus viaduct, with the cut belonging to it.

Chicago citizens are again complaining of the nauseating stench arising from the malodorous section of the city familiarly known as "Packingtown," otherwise the stock yards and packing house district, with its aggregation of gas and glue factories, rendering establishments, soap works and other stink-breeding accessories. Ordinarily this nuisance is regarded with but little attention outside of the immediate district, but the heavy southwest wind of Thursday of last week caused the whole city to suffer from the foul odors, with the result that the Chicago daily newspapers are pouring the vials of their wrath on the various manufacturing establishments deemed responsible for it all. Such crusades are so familiar to Chicago people, however, that little interest is excited over the present movement, and indeed it would be deserving of little notice were it not that it brings into prominence the almost criminal methods practiced by the city for the disposal of its garbage. Briefly stated, this is to cart the refuse, untreated in any manner, to dumping grounds in and about the city and leave it in heaps to pollute the atmosphere by the odors of putrefaction. The inadequacy of any such system for the sanitary disposal of the garbage of a city of the size of Chicago needs no demonstration, yet its evils might be partly condoned, objectionable as it is, if the dumping was done at a distance at which no nuisance would be caused the city or surrounding communities. Far from this being the case here, however, one of the largest dumping grounds of the city is located well within the city limits and not much over four miles from the City Hall. The condition of things here is described in the Chicago "Tribune" of July 27 as follows:

> The greatest source of all kinds of stench in the entire city can be found in the piece of land which lies on both sides of the Santa Fe railroad and extends for nearly half a mile between Ashland and Western Aves. This locality has evidently escaped the notice of the health officers. Several blocks of land on both sides of the track are being used as a dumping ground for garbage. The odor from the dumping grounds is so strong that the brakemen on the trains which pass by shut the windows of the coaches when the trains are within half a mile of the plague spot. A reporter for "The Tribune" visited the dumping grounds yesterday. East of the Santa Fe bridge which crosses the old canal is an open space extending several blocks. It is filled with garbage and filth taken from Chicago's alleys. The garbage contains considerable paper and combustible material, and sparks from the passing engines have set fire to it in a hundred places. From hundreds of little mounds rose smoke, which was carried toward the north to pollute the air. The entire area has been slowly burning all summer. It has been the dumping ground for city refuse for five years at least. There were nine teamsters dumping garbage there. Bad as is this spot, a little further west is another which is worse. It is not burning, as is the first. The dumping ground is alongside the canal. The water mixes with the refuse and aided by the rays of the sun cooks it and it seethes and sizzles, and the result is a green fermented liquid, which throws off an odor which is stifling. The odors which rise from here are constantly carried to different parts of the city.

A member of the staff of this journal has passed these dumping grounds on Santa Fe trains several times recently, and confirms the above statement in respect to the foul odors from these heaps of refuse. Further than this, the description is a sufficient comment upon itself. Such a system of garbage disposal would disgrace a country village; for a city of a million and a half of people it is little short of criminal.

The conditions here described in what its citizens are fond of calling the first city of America are a good illustration of the pertinence of the remarks in our last issue respecting the vast amount of educational work yet necessary to bring people to understand the principles of good sanitation and to realize the importance of observing them in securing the health of our large cities. Chicago is now expending millions of dollars in the construction of a canal to drain the sewage-laden waters of the Chicago River and protect its water supply from contamination, and at the same time is dumping the garbage of its million and a half inhabitants at its own back door. Only a few months ago the city's health authorities were struggling to stamp out an epidemic of smallpox among the ignorant population of its West Side slums, and at the same time the garbage contractors were dumping refuse to putrefy within a mile or two of the houses of these people. Other of our large cities are doing much the same thing as Chicago, although it is doubtful if any of the larger ones have an equally poor system of garbage disposal. St. Louis subjects its refuse to a chemical process designed to secure the useful portions for sale, rendering both these and the remaining matter inoffensive. New Orleans, formerly a synonym for all things unsanitary, is introducing a similar system of disposal. Philadelphia, beginning with this year, burns all its garbage, while New York, Brooklyn and Boston convey most of their garbage out to sea and dump it, except that in New York from last December to July the garbage was used in common with ashes and street sweepings for enlarging an island in the East River, as noted in our last issue. It is not necessary to discuss in this connection the comparative merits of the various systems of disposal. It is enough to say that no manner of excuse can exist for such a method of disposal as that now followed at Chicago. In the interest of public health it should no longer be tolerated.

No better argument for a radical and much-needed change in our present "system" of weights and measures could be produced than the fact that there should be a necessity for the law just passed by the Commonwealth of Massachusetts. The title of this law itself points the moral of the tale, for it is, "An act to establish a law uniform with the laws of other states for a uniform standard of weights and measures." It first defines the relation between the troy and avoirdupois "pound" as being 7,000 to 5,760, and says the hundred weight shall contain 100 lbs., and the ton 2,000 lbs., instead of 2,240 lbs., as is still the law in some states. The dry gallon is to contain 282 cu. ins., and the liquid gallon 231 cu. ins. The bushel in "heap measure" is to contain 2,150.42 cu. ins.; the barrel of flour is to contain 196 lbs., and the barrel of potatoes 172 lbs. Then follows a list of twenty-six "bushels" of various kinds of cereals, fruits, seeds, etc., with a weight value ranging from 20 lbs. to 60 lbs., a bewildering list for both producer and consumer to bear in mind. It is difficult to conceive why a legal weight value is necessary when a cubic volume is supposed to be implied by the term bushel. If these articles are to be sold by weight, and it is the better way, why not say so at once and eliminate the bushel entirely as a measure. It is an uncertain measure anyhow; it may be heaped or struck, and its cubic capacity, as compared with gallons or pecks, depends upon how it is filled. We still practically adhere to the old Winchester bushel of 2,150.42 cu. ins., which was the English standard since the days of the Anglo-Saxon kings; though England itself, in 1826, legally adopted the imperial bushel of 2,218.192 cu. ins. As a result the two great nations which have not adopted the metric system of weights and measures differ as to the values of one of the most commonly used measures of volume. No one will deny the necessity for measurements of capacity or cubic contents in many departments of science and construction; but these values should bear some fixed relations to linear units, as is the case in the metric system. But in trade units of weight could be substituted, we believe, with great advantage for existing very uncertain units of volume, and there is no better illustration of this fact than the law quoted; which is only one of many state laws on this head, and even these laws still differ in different states. The bushel, peck and gallon measures are inheritances from our Saxon ancestors, which came to us along with the pound, the acre, the rood, pole and perch, and it is about time that the whole antiquated and unsatisfactory system was dropped forever.

These are not good times for railway promoters, and especially for that class who get up schemes for the construction of long lines of railway, and endeavor to secure local aid from towns or counties along the route. People have been so many times victimized in this way that they are slow to take the bait. And yet, notwithstanding this, some few of these men still continue at their old trade. We are in receipts this week of some clippings from a local paper at Mauch Chunk, Pa., giving glowing accounts of the scheme which one William Dallin has spread before the people of that quiet Pennsylvania borough. This scheme is nothing less than an air line railway from New York to San Francisco. It is to run, however, via Chicago, which somewhat interferes with its "air line" pretensions, and Mr. Dallin kindly offers to bring the road "within three-quarters of a mile of Mauch Chunk," provided the good people of that town will subscribe the trifle of $300 towards the expenses of surveying the road through Pennsylvania, and $10,000 towards the company's bonds! For building the road Mr. Dallin proposes to get the United States Government to indorse his company's bonds to the modest sum of $400,000,000, and is said to claim that he closed a contract with an "English syndicate" last winter to take bonds to the amount of $125,000,000. If this last is true, we don't see why he is wasting his valuable time trying to raise $300 in Mauch Chunk. A correspondent in that town writes us for information as to Mr. Dallin's past record. Perhaps some of our readers who have had personal knowledge of his operations in other fields can supply it.

A lately issued "card of regulations governing students in Sibley College, Cornell University," is very brief in its text, but very broad in its application, and any earnest attempt to carry out these rules will redound to the profit of the student and the college. After calling attention to the fact that under the Statutes the Director shall control the "whole working" of the College, these two rules follow:

> (1) Every student in Sibley College is expected to show himself a gentleman at all times, within and without the precincts of the college.
> (2) Every gentleman attending Sibley College is expected to be a student.

A footnote to the first rule gives the Century Dictionary definition of "a gentleman," as follows:

> A man of good breeding, courtesy and kindness; hence a man distinguished for fine sense of honor, strict regard for his obligations and consideration for the rights and feelings of others.

For the purpose intended pages of "regulations" could not be any more effective than these two short rules honestly applied. Doubtless every college student is ambitious to be regarded as a gentleman; and as a rule ungentlemanly actions among

students spring from youthful folly and thoughtlessness. This little card then should be a useful reminder of the obligations and considerations here referred to, and it is safe to say that any well-meant effort to follow these rules will bring its own abundant reward in a nearer approach at least to that highest type of all students—the true gentleman and scholar.

Apropos of the long-standing line and staff difficulty in the navy, a good story is told of the exploit of a line officer on the coast defence vessel "Monterey" who thought he could improve the working of the hydraulic dashpots which take up the recoil of the 12-in. rifles in the vessel's revolving turrets. He ordered the machinists attached to the vessel to take out the plungers and reduce their diameter "between a quarter and half an inch." There was nothing to do but obey orders, so the plungers were removed, turned down and replaced. The report succinctly stated that several weeks would be required to repair the damage done when the first gun was fired. We cannot vouch for the truth of the story; but it is an excellent example of the results which are apt to follow whenever a man in authority undertakes to interfere in technical or special matters which he is not competent to handle.

Another good story illustrating the same thing used to be related by the late John C. Trautwine. In the very early days of railway engineering in this country young Trautwine was engaged as assistant engineer on the construction of what is now part of the Philadelphia, Wilmington & Baltimore R. R., under the famous William Strickland as Chief Engineer. The Board of Directors of the company (and it was in the days when a director was something more than a figure-head in the management of a company's affairs) included several wealthy old Philadelphia Quakers; and while the line was in process of construction the directors were one day escorted over the line of the road by the Chief Engineer. In those days everything connected with railway engineering was a novelty and a great deal of explanation was necessary to the inquisitive directors, who must needs know every detail of the work. One shrewd old Quaker in his tour over the road came along where young John C. Trautwine, with whom he chanced to be personally acquainted, was setting slope stakes, and the young engineer explained at the elder's request the mysteries of the process. The old Quaker was an apt scholar, so apt that he at once felt called upon to better the instruction. "John," said he, "does not thee see that it makes a needless handling of earth to set the stakes so far up the hillside? Why dost not thou move them down a little way and thus lighten the labor of excavation?" John explained that the line of the road had to be laid out in somewhat different manner from an ordinary highway, and that detours to suit every variation in the surface of the ground were not permissible. The old Quaker was not convinced, however. "Thy theories are all very fine, John," said he, "but the practical man, who has to pay for this work, looks at it with a different eye. We cannot permit extravagant work to fit thy fine spun theories. I will show thee where to set thy stakes to suit the purpose with much greater economy." As the old man insisted that the stakes should be moved to suit his views, young Trautwine was in a quandary and appealed to Mr. Strickland, who happened along just then, as to whether the stakes should be moved. "Certainly," said the Chief when the situation was explained to him. "Mr. Blank is a director of the company, and the work must be done as he requires it," and in an aside, "I'll teach him not to interfere with my assistants." The old Quaker was delighted with the idea that his ability as a "practical" man had been recognized by the astute Strickland. He went over the ground "measuring with his eye," and gave orders to John where each stake should be set, accompanying the work, we may be sure, with sage instructions to the younger man as to the superiority of "practical" knowledge to theoretical.

The work was done according to the director's stakes; and in the course of time the grading was completed and a large party of officers, prominent stockholders, leading citizens, etc., were escorted over the finished roadbed. In the course of the journey they came across a place on a long tangent where the line made a sharp crook to one side, in a manner which may be imagined. There were instant and numerous appeals to the Chief Engineer to know the reason for this abnormal bend in the road. "That," said he, "is where one of your directors insisted that he knew more than my assistants and staked out the grading to suit himself. It will have to be changed, of course, before track can be laid over it, but it may be worth all it cost if it shows you that there'll be no money saved on this work by interfering with the engineering department."

RESILIENCE AND THE STUDY OF DROP TESTS.

With all the increase in the use of testing machines, and with all the great increase in the use of and reliance upon tests and specifications which has taken place during the past score of years, there is still no small amount of prevalent skepticism as to the value and reliability of the results obtained in the modern tensile test. A good deal of this skepticism is probably due to a failure to properly understand and interpret the results which are shown by such tests; and at the risk of giving our readers some very elementary matter, it seems worth while to set forth some foundation facts respecting modern practice in testing. There are three fundamental qualities which a properly conducted tension test aims to determine. They are: (1) The elastic limit, (2) the ultimate strength, (3) the percentage of elongation. Reduction of area is by many engineers considered fully as important as elongation; but we have not included it in this list, because it depends on the same, or nearly the same, qualities in the metal as elongation. Of these three qualities the ultimate strength is the only quality which is appreciated and understood by the general public; and perhaps some engineers, consciously or unconsciously, attach an undue value to it. The ultimate strength is a thing which any one can comprehend, and in the infancy of testing it was considered the one main thing to be determined. For example, take the standard form of test piece for boiler plates adopted many years ago by the United States Government and tenaciously clung to long after its absurdity had been exposed. As will be remembered the piece of plate to be tested had a semi-circle punched out on each side, so that practically nothing but ultimate strength could be ascertained with any approach to accuracy.

Now the elementary fact which ought to be firmly fixed in the mind of every engineering student at the beginning of his studies of the properties of materials is that the chief quality of materials which we aim to determine by our modern testing apparatus is not the breaking strength, but the qualities of resilience and toughness. A brittle material like glass may have an ultimate strength as great as that of wood, but it is valueless for any place where shock is to be sustained. Steel can be so made and treated as to be as hard as chilled iron and with an ultimate strength beyond that of any other known material, but a slight shock upon such metal will cause it to snap, unless, as in the case of Harveyized or compound armor plate, it be supported by softer and tougher metal behind it. Of course there are cases where material is to be subjected to a quiescent load only, where the ultimate strength is the important thing to be ascertained, as in the case of building stone, or, in some cases, of cast iron; but it is nearly always true where materials in engineering construction are loaded up to their "working strength" that what is most desired is, first, resilience, or the power to absorb the energy of a shock or blow, without injury or permanent set; and, second, toughness, or the power to stretch or bend without fracture when subjected to a blow which causes strains beyond the elastic limit. Some writers prefer the terms "elastic resilience" and "ultimate resilience" for these two qualities, and Mr. Coxe, in his translation of Weisbach, used the terms "resilience" and "fragility."

Whatever the name by which they are known, it it unfortunate that these two qualities of material are not more clearly understood by engineers and engineering students. The fact is not as generally appreciated as it should be that the resilience of a metal may be stated in foot-pounds per unit of volume, just as its strength under static strain may be stated in pounds per unit area of cross-section.

Let us take as an example a floor beam hanger of 1 in. square section and a foot in length. Its ultimate strength may be 55,000 lbs. Suppose now it is subjected to a blow or shock. The hanger can absorb shock in only one way, by yielding or stretching under the blow, exerting a continually increasing resistance, and its resilience or "elastic toughness" will be the product of the average resistance exerted by it (between the points of no load and the elastic limit) and the total stretch in the metal at the elastic limit. Thus if the elastic limit of the metal be 35,000 lbs., the average resistance exerted will be one-half this, or 17,500 lbs. The total stretch, assuming the coefficient of elasticity at 28,000,000, will be $\frac{35{,}000}{28{,}000{,}000}$ of its length, or 0.00125 ft. Then the resilience will be $17{,}500 \times 0.00125 = 21.875$ ft.-lbs.

But the amount of shock which the metal can absorb after it passes the limit of elasticity is greatly in excess of this. If we suppose the average resistance of the metal when stretched from the elastic limit to the point of rupture to be 52,000 lbs. per sq. in., and the total elongation at fracture to be 30% of the original length, we have (neglecting that part of the elongation which occurs before the approximate ultimate strength is developed) $52{,}000 \times \frac{30}{100} = 15{,}600$ ft.-lbs.

In this lies the great disparity between a hard brittle material like cast iron and a soft ductile material like mild steel. The resilience, or amount of work, which each can absorb without taking a permanent set is small for each material. But a slight excess of strain over that required to give the metal a permanent set will cause the cast iron to snap, while the steel will be merely permanently elongated.

But the objection may be made that this is theory, based on the results of tensile tests alone, and it may fairly be asked to what extent it is possible that actual impact tests might give different results. In answer to this it must be said that for the most part the above statements rest on assumptions as well proved as any truths in the whole range of mechanics. We know absolutely, for example, that the only manner in which a body can absorb the energy of a blow is by exerting a resistance to it, and that any force, no matter how slight, exerted on any body, no matter how strong, causes it to yield to a certain extent. We know also that the work done by this resistance must equal the resistance multiplied by the distance through which the resistance is exerted. We do not absolutely know, however, that either the elastic limit or the ultimate strength is the same for the load caused by a sudden shock as for a load gradually applied, nor can we certainly say that the elongation within the elastic limit, or that which takes place before fracture occurs, is the same for a body broken by a shock as for one broken by a steady load.

For these reasons it becomes desirable to test material which is to be subjected to shocks by an impact or drop test, and this is desirable for still another reason. The fracture of materials under shock appears to be affected not only by their strength, elasticity and elongation under load, but by their internal structure. In a crystalline homogeneous material, like porcelain, for example, a separation of the molecules at any point may extend entirely through the piece. In common parlance, "crack it and it is gone." On the other hand, a fibrous material like wood is like a bundle of threads, the breaking of one of which has no influence to cause the breaking of the others, save as the strength of the whole is decreased by the loss of the strength of the broken fiber. This is the argument which has long been urged against steel, as compared with wrought iron, and which is still occasionally heard. The iron is weaker than the steel on account of the impurities which are incorporated in it in the form of a slag; but these minute layers or threads of slag serve to separate the iron into a multitude of fine fibers, and serve to prevent a crack from extending from one fiber to the next.

For the detection of brittleness due to internal structure, then, as well as to determine the behavior of ductile material under shocks, the drop

test is a valuable one, and although it has serious limitations as respects accuracy, and has been replaced in many cases by tensile tests, it does fill an important place in modern engineering, and is not at all likely to be dispensed with, especially as it is applicable in some cases where no other test can be used.

As thus far used, however, the drop test has been chiefly applied to finished work, such as steel rails, car wheels and couplers. Experiments on the effect of impact on test specimens have been exceedingly few. During the winter of 1893 Mr. E. D. Estrada, of the firm of Estrada, Kenyon & Gray, of Pittsburg, conducted a series of impact tests in a machine of his own design. The results were presented in a paper read by him before the Engineers' Society of Western Pennsylvania, which excited considerable interest and discussion. Elsewhere in this issue we give a condensed abstract of that paper, and of the discussion which followed it. It is with the hope of clearing up some of the doubts and difficulties which appear to have arisen in interpreting the results of this test that we have undertaken this discussion.

We have reviewed above the general manner in which the behavior of metals when tested under the drop is predicted, from what we know of their behavior in the ordinary testing machine. Let us consider now what actually happens when a piece is stretched by impact.

Suppose the rod A B is suspended from the fixed support F, and the weight W is allowed to fall and strike its lower end. If the support were an absolutely fixed body, and had in addition the qualities of absolute imcompressibility and infinite strength, which the ancients ascribed to the mythical substance adamant, then the whole energy of the blow would be absorbed in two ways: (1) by heating of the metal through the concussion of the molecules of the striking and struck surfaces; (2) by the stretching of the rod.

Suppose, for example, the rod be 1 ft. long, 1 sq. in. in cross-section and the weight of 100 lbs. be permitted to fall 1 ft. It is desired to know what tensile strain is induced in the rod by such a shock. We can measure the permanent set produced, and we know, of course, that under the above theoretical assumption of supports absolutely unyielding and colliding surfaces absolutely elastic, 100 ft.-lbs. must have been absorbed by the rod. Here our experimental knowledge ends, however, and we are compelled to fall back on our knowledge derived from tensile tests, and to assume that the behavior of the metal is the same when under shock. Accepting this assumption, we may then determine the energy which the piece would absorb in stretching from quiesence to the elastic limit. The remaining energy must have been absorbed in giving the observed permament set to the metal, hence dividing the quantity representing the remaining foot-pounds of energy by the observed permanent set, we have the average resistance exerted between the elastic limit and the point of maximum resistance.

The above represents the limit of what is theoretically possible. In applying the method to actual work in testing, we are met at once by the fact that part of the energy of the falling weight is absorbed by the support of the test piece, and by the foundation of the machine, and another part goes to heat the colliding surfaces. We can do no more than roughly guess at either of these quantities.

For these reasons it may be set down as an absolute impossibility, with any form of machine or apparatus that could be devised, to determine exactly what tensile or compressive strain is produced in a body by the impact of a certain energy.

But it does not at all follow from this that the impact test may not be a most useful method of testing. On the contrary, its value will be increased rather than lessened by a clear understanding of the conditions which control it. It is by no means necessary that we should be able to reduce the results of the impact test to pounds per square inch and percentage of stretch in order to derive important knowledge from it.

The great value of the impact test is that it imitates far more closely than the ordinary testing machine the conditions under which material fails in actual service. It is a question whether engineers in general do not come too habitually to consider the static forces acting on a structure or machine to the neglect of the dynamic forces. For example, it is proverbial that a chain is no stronger than its weakest link; but how many engineers fully appreciate the fact that a chain with all its links uniformly weak will resist a much greater shock than a chain with only one weak link and a hundred strong ones?

In another column of this issue we give some space to a paper by Mr. Geo. H. Thomson, discussing a rather peculiar theory of his concerning "structural motion." Apparently it is this very idea that Mr. Thomson is contending for in his paper—that a structure with all its members of uniform strength can resist far greater shock than a much heavier structure in which the energy of a shock will be concentrated upon the weaker members.

We have alluded above to the experiments of Mr. Estrada, and believe that he deserves much credit for his zeal in this new field of engineering research, although his methods were not entirely well chosen. It is to be hoped, however, that experiments with this class of machines will be continued, especially with a view to determining the behavior of test pieces under much lighter shocks than those used by Mr. Estrada. His claims that the ultimate strength and elongation are much higher under shock than under slowly applied load will hardly be accepted as conclusively proved by many engineers; yet it is not impossible that there may be truth in the claims. We know that a test piece broken in a machine fails not by uniform stretching throughout its length, but by "necking down," and most of the stretch and reduction of area takes place near the point of fracture. It is by no means impossible that under a shock the metal may not have time to concentrate its elongation at a single point, but that it stretches with great uniformity throughout its length, thus increasing its elastic limit, ultimate strength and percentage of elongation. If it is really true that this takes place, then it follows that metals under shock can absorb a greater amount of energy than the results obtained in the testing machine have led us to suppose. It is fair to say in this connection, however, that in drawings, accompanying Mr. Estrada's paper, the necking down appears to be substantially the same for the specimens tested by impact and those tested in the screw machine.

In conclusion, it may be worth while calling attention to the great importance in all impact tests of taking into consideration the support of the piece to be tested. A considerable part of the energy of the blow will inevitably be absorbed by this foundation, and if this is elastic and yielding, the actual strain induced in the piece under test may be exceedingly small.

THE PROPOSED COMMISSION ON PUBLIC ARCHITECTURE.

The late controversy between Secretary of the Treasury Carlisle and President Burnham, of the American Institute of Architects, promises to have good results. Under the present law the government architect may or may not be the best man for his responsible position, for the people of the United States are purely at the mercy of the whim or ignorance of technical matters of the Secretary of the Treasury for the time being, and it is not necessary to here point out that more than once the architect responsible for the design of public buildings was unfit for his task. Bad design and rotten construction characterize too many of the buildings for which Uncle Sam has paid.

Mr. Burnham contended in effect that the existing law authorized the Secretary of the Treasury to open to competition among the architects of the country the designing of government buildings. Mr. Carlisle was miffed at the plain speech of the President of the American Institute and declined to carry the law into effect; and it is difficult to see how any good could have resulted anyhow unless the law definitely stated how and by whom the good designs and competent architects were to be selected from the mass of men and material that this public competition would have unloaded upon the Treasury Department.

But the bill introduced into Congress last month by Representative McKaig is an outcome of this agitation, and its passage would certainly work a vast improvement upon existing methods. It is said to be supported by the architects and is framed with the intention of meeting the views of both parties, the government and the architects. Under the provisions of this bill the President is to appoint a commission on public architecture, made up of three prominent architects, of high scientific and artistic training and wide practical experience, and two officers of the army engineer corps. This commission, under the Secretary of the Treasury, is to procure designs and appoint architects for all buildings hereafter to be erected by the government. The Secretary of the Treasury is to be President of the Commission, ex officio, and the Supervising Architect is to be a member, ex officio. The commission is to frame and adopt rules and regulations governing the submission and selection of competition designs. The pay provided for is expenses of all kinds and $10 per day for the architect members only during the time that they are actually employed.

In the case of a building to cost $100,000 or over, this commission selects by ballot five architects to prepare designs in competition; and in case the cost is less, the commission may in like manner select one architect to execute it. Any competitor must have had at least ten years' actual practice as an architect in chief and must satisfy the commission that he is competent to take economical charge of the proposed building. Each unsuccessful competitor will be reimbursed at a stated and moderate rate for expenses incurred in preparing his plans.

The author of the selected design is to be recommended as the architect of the building and appointed as such by the Secretary of the Treasury. He performs all the duties customary to an architect in private practice; supervises construction, and before payment can be made to contractors his certificate must be obtained. He will receive for this the usual architects' commission of 5% of the total cost of the building, together with his traveling expenses. The Supervising Architect is to remain as the official representative of the government; receive proposals and award contracts, and otherwise act for the government in all matters connected with the erection of public buildings.

The army engineer officers are presumably put upon the commission to represent the government there, and if they are selected for their especial technical knowledge of structural work they can doubtless materially assist the architects in matters connected with the construction of large modern buildings, where civil engineering plays so large a part. The Supervising Architect's office is an important executive one, apparently, and it is undoubtedly necessary to have some permanent official directly connected with the government to control the general office detail of government construction. The pay of the commission itself is not an extravagant one, and the framer of the bill seems to count somewhat heavily in that connection upon the unselfish devotion of prominent architects to the general advancement of architecture and the material interests of their fellow-architects.

But the bill marks a decided step in advance, and should have, if made a law, as marked an influence for the better upon our public architecture. As it is now, the government is not in a position to benefit by the services of our best architects, simply because the individual will pay more for their brains and artistic and structural skill than the national government. The salary of the Supervising Architect is a paltry one to many architects in private practice, and if prominent men can be induced to accept the office at all, it is accepted at a sacrifice of private financial interests. But under this bill the question of proper compensation for government work is settled and the dimensions of much of this work and the opportunity for a display of the many attainments that unite to make a thoroughly competent architect would doubtless attract some of the very best men in the profession and result in the erection of public buildings more worthy of the culture and wealth of this country than is possible under present controlling conditions. All friends of good taste and sound construction will hope, with us, that this bill may

become a law as speedily as possible. There is some consolation in past practice, in the fact that some of the worst of the old buildings will soon be, of necessity, removed, and under this law there would be a chance of having them replaced by more artistic and sounder structures.

LETTERS TO THE EDITOR.

MORE NEW STADIA RODS.

Sir: I noticed in Engineering News of May 17 a new design for a rod for stadia and level work, by C. K. Allen. The rod is surely an improvement upon stadia rods in general use, yet it does not obviate a feature which is always a source of annoyance to the transitman, viz., the similarity of stadia rods throughout their whole length.

Fig. 1. Stadia Rod, designed by Mr. T. D. Allin.

Fig. 2. Stadia Rod, designed by Mr. C. K. Allen.

I inclose a drawing of a rod which I designed and have used some four years, which, I claim, includes all the admirable features of Mr. Allen's rod, and at the same time breaks that objectionable similarity, and for that reason alone it is the best rod for rapid long distance work that I have ever seen.

No figures are used, which at best are eye strainers on long distance work. The rod is 12½ ft. long, with the second 5 ft. marked the same as the first 5 ft., as shown in the drawing, while the last 2½ ft. is marked the same as the first 2½ ft.

For distances greater than 250 ft., 250 becomes a unit, and at a glance the transitman can read any multiple of 250 and then add the remaining interval in the usual manner.

The body of my particular rod is only 2½ ins. wide, is ¾ in. thick at the bottom and gradually reduces to ½ in. at the top. On each edge is a 5-16-in. strip extending out ⅜ in. past the face of the rod. These strips stiffen the rod, protect the face and prevent warping. The rod, with the shoe, balances just above the 5-ft. point and is a very light and convenient rod to handle. Of course the width, as well as the marking, can be varied to suit the fancy of the transitman. It is only to the system of blocking conspicuously to indicate some unit greater than one foot, that I desire to call special attention. Yours truly, T. D. Allin.

Pasadena, Cal., June 16, 1894.

(To facilitate comparison of the two graduations we reproduce our illustration of Mr. Allen's rod, from our issue of May 17.—Ed.)

Sir: Your paper has published several articles on the stadia and its uses, but so far as I can learn no attempt has been made to do away with the tedious office calculations necessary to reduce distances obtained by inclined sights to their horizontal equivalents.

In the rod I have designed, it is not my purpose to eliminate the error due to the slightly varying distance of the "focal length," but the two errors in every inclined sight due, first, to the difference in length between the hypothenuse a b, or line of sight, and the base b c, or required distance; and, second, to the angle at which the line of sight intersects the vertical plane or rod, e e, in Fig. 1.

The ground must be exceptionally rough where by a careful selection of instrument points the maximum vertical angle cannot be kept below 11°.

By Fig. 2 I determine the distorted equivalent of one

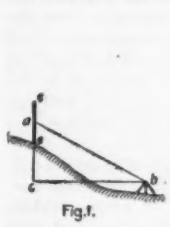


Fig. 1.

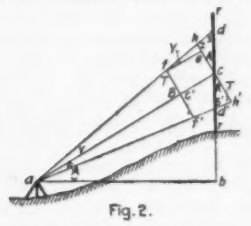


Fig. 2.

foot for any vertical angle and on this basis I have prepared a rod having four faces—one, a U. S. standard face, divided into feet, tenths and half-tenths, and the other three faces divided the same, except that the graduations are proportioned to vertical angles of 4°, 7° and 10° as described in Fig. 2.

Assume a to be the instrument and r r the rod. A = vertical angle of line of sight, and we wish to read the distance a b. a b = 100 ft.; a c′ = a b and f f′ = 1 ft.; a c = a b × secant of A. Then $\frac{f\,f'}{2}$ = f c′ ÷ ac′ = tan Y and a c − a c′ = c c′ = e f. From angle Y and side e f find e h and e h + e c = c h = c h′. Find angles S and S′; then sin S: sin Z :: c h : c d; and sin S′ : sin T:: c h′ : c d′; and c d + c d′ = d d′ = the distorted equivalent of f f′ for angle A. Or instead of all this, the square of the secants of the angle A gives d d′ the same to the thousandths place, which is practically correct.

The maximum error that can occur by using the U. S. standard face for all vertical angles up to 2° 50′ is, 0.24 ft. per 100 ft. of sight.

The rod will be built hollow, making it no heavier than an ordinary level rod and yet having a constant length of 11 ft. It will be jointed in the center and made rigid by a square hardwood dowel which will be, for half its length, inside of and secured to the upper half and will fit tight into the lower half through a brass plate which protects this end during transportation as the dowel does the other abutting end, thus rendering the graduations at the joint permanently accurate.

The graduations used on an ordinary level rod not being adapted to stadia work, I have adopted graduations composed of right angle triangles with the hypothenuse of each on alternate sides of a vertical line (see Fig. 3.) Thus their extremities form the tenths and their apexes the half-tenths.

This style of face can be accurately read at any distance at which the face of the rod can be distinctly seen.

The graduations proper are ten feet in length on the U. S. standard face, with a target design at the center and at each end (see the center target in Fig. 3), and by locating the lower target on this face, one foot from the point, the rod can be used for any level work where the ordinary level rod graduated to half-tenths can be used. These rods are now being manufactured by Messrs. W. & L. E. Gurley.

Fig. 3.

For nearly a year I have used one of these rods with the most satisfactory results. It insures much more rapid work in the field because of the clearness of the graduations and saves an immense amount of office work. Yours very truly, Edmund C. Stout,

Assoc. M. Am. Soc. C. E.

Scarborough-on-Hudson, N. Y., April 21, 1894.

A RATIONAL FORMULA FOR COLUMNS.

Sir: In your issue of July 19 appears an article by Prof. Mansfield Merriman on "The Rational Design of Columns," in which he deduces a formula identical with the one proposed by John D. Crehore, C. E., in Van Nostrand's "Eclectic Engineering Magazine" for December, 1879, and subsequently reproduced with full and elaborate comparisons of results in my father's book, "The Mechanics of the Girder," John Wiley & Sons, New York, 1886.

Professor Merriman's formula for safe load is

$$B = \frac{C}{1 + \frac{n\,C\,l^2}{\pi^2\,E\,r^2}}$$

where n = 1 for a column having both ends round, n = 4·9 for a column having one end round and one fixed, and n = ¼ for a column having both ends fixed. Making these substitutions and tabulating the three forms for the sake of comparison with Mr. Crehore's formulas, we have the following:

	Prof. Merriman's.	J. D. Crehore's.	
Both ends round..	$B = \frac{C}{1 + \frac{C\,l^2}{\pi^2\,E\,r^2}}$	$Q = \frac{C}{1 + \frac{C\,l^2}{\pi^2\,E\,r^2}}$	eq. (381) p. 292.
Both ends fixed....	$B = \frac{C}{1 + \frac{C\,l^2}{4\,\pi^2\,E\,r^2}}$	$Q = \frac{C}{1 + \frac{C\,l^2}{4\,\pi^2\,E\,r^2}}$	eq. (385) p. 293.
One end round and one fixed...	$B = \frac{C}{1 + \frac{C\,l^2}{2.25\,\pi^2\,E\,r^2}}$	$Q = \frac{C}{1 + \frac{C\,l^2}{2.28\,\pi^2\,E\,r^2}}$	eq. (391) p. 295.

Between the methods used by the two authors for deducing their identical results, there is a wide difference. Professor Merriman starts by assuming the general formula of Gordon and Rankine to be correct, and thus detracts somewhat materially from the rationality of his results, if we suppose Gordon's formula to be empirical, as is commonly accepted. Mr. Crehore, on the other hand, set out to show from purely rational considerations that Gordon's empirical formula was correct, or nearly so, and that a purely rational formula for pillars could be derived that was no more cumbersome than the Gordon formula, but was more reliable. A reference to Chap. VII. of "The Mechanics of the Girder" will show how these results were accomplished. Very truly yours,

Wm. W. Crehore, Assoc. M. Am. Soc. C. E.

New York City, July 20, 1894.

(The above letter was sent to Professor Merriman, who has made the reply given just below. —Ed.)

It is true that Mr. Crehore's discussion leads to the same formulas as mine, and I should have referred to it but for the fact that he considers the subject throughout from the standpoint of rupture instead of from that of resistance within the elastic limit. For instance, he says: "Let C = crushing strength of standard specimen of the material, P = breaking weight applied at the end of the pillar, Q = P ÷ S = breaking weight per square inch of cross-section." His deduction starts with the sentence: "Since the full unit-strength of the unloaded pillar is C, and the remaining unit-strength of the loaded pillar's cross-section is (C − Q), it follows that the expression for the moment of the internal forces developed in any cross-section must be diminished in the ratio (C − Q) ÷ C." Then he modifies Euler's demonstration by this assumption, and deduces the formulas, which he applies to discussions of the rupture of columns covering eight pages, and rests his case upon the close agreement between the computed values of Q and those found by tests to destruction.

My demonstration shows, on the other hand, that the formulas are not true for cases of rupture, and that they are only true when the elastic limit of the material is not exceeded. With regard to the point raised that I should not start with Rankine's formula because it is empirical, I may remark that it is only the numerical forms which are empirical, while the literal form,

$$B = \frac{C}{1 + q\,\frac{l^2}{r^2}},$$

is entirely rational within the elastic limit of the material, as may be seen by reference to Rankine and to numerous other text-books.

Full credit is due to Mr. Crehore for having been the first to state these formulas, notwithstanding his apparent deduction and application of them for cases of rupture only. His discussions did not come to my notice until after my investigation was entirely completed, but although leading to the same algebraic expressions they seemed to contain little to strengthen my argument, which was intended to be based throughout on the solid ground of the laws of elastic resistance.

Mansfield Merriman.

South Bethlehem, Pa., July 27, 1894.

THE RATIONAL DESIGN OF COLUMNS.

Sir: Professor Merriman has undertaken a much needed work in the article which appeared in Engineering News of July 19 on the subject of "The Rational Design of Columns." Of all the various formulas for columns which have been proposed, none enables us to determine the maximum fiber stress for any given condition of load. We are not as yet in possession of a complete theory of the stresses in a column by which we can follow the forces exerted by a given load during transmission through the column, so as to determine the stress conditions at any section, and at different parts of the same section, as the accepted theory of transverse stress enables us to determine the stresses throughout a beam.

Professor Merriman in his paper has made a start in

the right direction, and while the present writer cannot accept the immediate results of the Professor's efforts, he cannot but hope that it will ultimately bring good fruit, by directing attention to this important matter, and stimulate other researches in this direction.

Professor Merriman starts out with two assumptions: (1) That the reasoning of Gordon and Rankine is correct, from which the well known Gordon-Rankine formula is derived; (2) that Euler's formula for very long columns is also correct.

The first assumption is not well founded. Professor Rankine himself ("Applied Mechanics," p. 300) distinctly states that the theory is unsatisfactory, and the formula "must be regarded as provisional only." Many members of the profession seem to have overlooked these qualifying remarks, and because this great man's name has become identified with this formula they assume that its correctness has been fully demonstrated. It is to be regretted that Rankine did not enlarge upon this point and indicate in what respect the theory was unsatisfactory.

In Engineering News for Dec. 22, 1888, and Feb. 23, 1889, and again in the Transactions of the American Society of Civil Engineers, vol. XXVII., p. 92, the present writer set forth what he conceives to be the real weakness of this theory, which Professor Rankine probably had in mind when he pronounced it unsatisfactory. Gordon followed Tredgold's assumption, that a load imposed upon a column produces a direct compression equal to the imposed load, and also a bending moment, in estimating which he also used the full amount of the load. This assumption requires the load to perform double duty, which is incompatible with the principle of conservation of energy.

The true hypothesis requires us to conceive of the load as divided into two parts, one of which produces bending moment and the other direct compression; the ratio of these two parts varying with the length of the column. When the column is very short and no bending occurs, the entire force is expended in direct compression. When the column is very long the entire force is expended in producing flexure, and there is no direct compression. For intermediate lengths, both conditions exist at the same time, each condition being that due to its proportion of the load.

When the length is such that the energy of the load is wholly expended in producing flexure, we have the conditions from which Euler's equation was deduced, and which Professor Merriman accepts as correct.

On the other hand, under Tredgold's assumption the direct compression to the full value of the load must always be present, and Euler's hypothesis can never exist. Professor Merriman's attempt to establish the conditions which would make the curve of Rankine's formula tangential to that of Euler's must therefore fail, as indeed he has shown, although he interpets the failure in a different light. He shows that these two curves have a common point only when $\frac{l}{r} = \infty$, from which he concludes that Euler's equation does not apply to finite values of $\frac{l}{r}$. What this deduction really shows is, that these two equations, both of which he assumes to be correct, are in fact incompatible. In both equations $\frac{l}{r}$ enters as a divisor, and when this factor becomes infinite the load becomes zero. It is this fact of the load becoming zero which eliminates the direct compression and brings the two equations together. As long as the load has a finite value the two curves cannot coincide, for the one requires that there shall be no direct compression, and the other that there must be.

The two assumptions which form the basis of this paper being demonstrated to be incompatible, one or the other must be false, and it becomes necessary to choose between them.

The present writer has no hesitation in rejecting Tredgold's hypothesis, and all formulas based thereon, for the reasons stated; and he firmly believes that the true solution of this problem must be based upon the hypothesis that the sum of the energies expended in compression and in flexure must equal that of the imposed load. How to reach the law governing the division of the load to these two forms of energy is at present obscure, and the present writer has no suggestion to offer. He further believes that when the theoretical solution of the problem is found, it will not be very far from the straight line tangent to Euler's curve which is established empirically by experiment. Certainly, the true equation must merge into Euler's within the field of finite values, although beyond the length of ordinary practice.

It is to be hoped that Professor Merriman, and others equally fitted to carry out these researches, will continue this good work; but to arrive at the truth they must abandon Tredgold's hypothesis, which is clearly erroneous.

Thos. H. Johnson.

Pittsburg, Pa., July 24, 1894.

(We have submitted this letter to Professor Merriman, who states that he regards the theory of Rankine as entirely sound and strictly in accordance with the fundamental laws of statics. In his copy of Rankine's "Applied Mechanics" (1882) it is not said that the theory is unsatisfactory, but merely that a complete theory does not exist, and that the investigation is partly theoretical and partly empirical. The theoretical part is satisfactory as far as it goes, but it is incomplete because it leaves an undetermined quantity in the denominator of the formula. Mr. Johnson's principle, that the sum of the energies expended in compression and in flexure must equal that of the imposed load, is undoubtedly a correct one, but it does not at all contradict the established theory, and its development would furnish additional confirmation. In order to develop it the internal work for every fiber at every section of the column must be obtained, and their sum be taken. The Rankine formula deals only with a single fiber at the middle of the column on the concave side. The total unit stress, C, at this point is, if B be the unit load,

$$C = B + B\ q\ \frac{l^2}{r^2}$$

while on the convex side at the middle of the column the unit stress, C, is,

$$C_1 = B - B\ q_1\ \frac{l^2}{r^2}$$

and if similar expressions be written for all the fibers, and these be added, it will be found that the sum of all the C's is equal to the sum of all the B's. Hence the two methods lead to the same conclusion. Professor Merriman also states that he regards Mr. Johnson's straight-line formula as the best empirical one, but he fails to see that it has a rational basis like that of Rankine.—Ed.)

EFFICIENCY OF AIR AND FOUNDATION BRAKES.

Sir: It has been with a great deal of interest and benefit that I have read the article in your issue of May 3 on "The Efficiency of Air and Foundation Brakes," by Waldo H. Marshall. Much valuable time and no little money must have been spent in the collection of the data and the carrying out of the experiments, and it has been cause for surprise that more comment has not been made upon the results shown in the article, by those most directly interested.

Having made a number of tests of air-brakes on freight cars within the past 18 months, for the purpose of obtaining information for the use of a car supply company, it may be interesting to your readers to know how the results of such tests verify, as far as they go, the results found on passenger cars given in Mr. Marshall's paper. The tests were made with the object of obtaining the actual braking pressure of the shoes against the four wheels of each truck, and this was accomplished by discarding the dead lever guides and placing in their stead oil cylinders. The stirrups used for connecting the opposite ends of these cylinders to the brake connections were placed at right angles to each other and were made quite loose and free so that the plunger and cylinder were self-centering to the line of pull of the connections. The internal friction of each cylinder amounted to about 2 lbs. per sq. in. of cylinder

It will thus be seen from the location of the cylinders that the following losses would be accounted for: Cylinder release spring, piston packing friction and foundation brake friction, leaving the loss from inclination of brakebeam hangers the only one unaccounted for. In most cases the brakes were "outside hung," having long and nearly vertical hangers which necessarily did not consume much power. Each of the above cylinders was connected by a flexible metal pipe to a pressure gage placed within the car; the area of cross section of each cylinder being such as to give (in hundreds of pounds) the total braking pressure on the four wheels of its corresponding truck. By the side of the oil cylinder gages two air gages were placed, one connected to the auxiliary reservoir and the other to the brake cylinder. It will thus be seen that when in operation the air pressure in both auxiliary reservoir and brake cylinders could be instantly read, together with the total braking pressure on the four wheels of each truck.

Before taking up the results obtained by the writer, allow me to draw your attention to one part of Table I. of Mr. Marshall's paper, which you have not published (the effect of the interchange of freight cars from one road to another). The table shows the amount of air pressure used in train pipe and the percentages of load on wheels used as brake pressure by various railways. One road having over 25,000 freight cars allows a train pipe pressure of 65 lbs. and a braking pressure of 80% of weight of car; another road allows a train line pressure of 90 lbs. Now when a car from the former road passes to the latter, a braking pressure of 110 7-10% is obtained. Under these circumstances what becomes of the wheels?

On the other hand, if cars from the latter road go to the former, the braking pressure on such cars will be 50% of their weight, and this too without allowing for any losses in the foundation or air-brakes. These are extreme examples, but other roads in the table approach them very closely.. Another somewhat surprising thing shown in this table is that a road having over 12,500 freight cars allows only 25% of weight of car for braking pressure. Must it not necessarily be the case that cars of other roads are made to do most of the braking for this road's cars?

The tension of brakebeam release springs is a source of loss upon which "work" has to be done by the air in the cylinder, besides applying the brakes. However, the brakeshoes, particularly in passenger service, must be withdrawn from the wheels immediately upon their release, and when hangers alone are used, their rapidty of action is dependent upon the amount of inclination of the hangers and their mechanical design and erection. If short and put up without great care, they will cause great loss of braking power. One example in freight service will illustrate this and at the same time show how the apparently small matter of allowing a little paint to get near any pins or joints will seriously affect results desired.

In a series of tests with the apparatus described above and applied to one car having "inside hung"

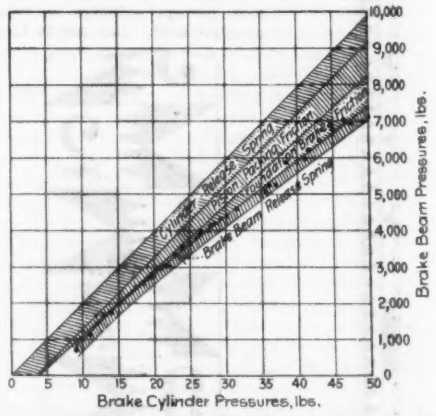


Diagram Showing Losses of Pressure Between Air-Brake Cylinder and Brakebeam as Determined by Running Test.

brakes with short stirrup hangers placed at a large angle to the vertical to enable the hangers to work quickly, and another car having "outside hung" brakes with long eye hangers depending from the car body and placed at a small angle from the vertical, and both cars being supplied with the same make of air-brake, the following result was obtained: When the brakes were applied with a service application, the car having short inside hangers showed a loss between cylinder and shoes of 63%; whereas the car with long outside hangers showed a loss between the same points of 46%. This difference was so great that the oil cylinder was examined with the expectation of finding it out of order. Such, however, was not the case, and further tests verified the first readings. The foundation brakes were then entirely dismantled, joints cleaned and oiled, and in so doing it was discovered that when the car was painted the hangers and some of the joints had received a coat of paint. When put in operation again they showed a loss between cylinder and shoes of 51%, equal to a gain of 1,200 lbs. on each truck. It will be noticed that the short "inside hung" hangers having large angle from the vertical, caused the greater consumption of power. The high percentages of loss are due in these cases to the fact that the tests were made on standing cars.

Some interesting points were disclosed in the tests as to friction in the foundation brake. The cars tested, from which the following results were obtained, were freight cars having the quick action automatic brake and M. C. B. foundation brake, and had been in service several years. They were equipped with oil cylinders, as previously described, and had "outside hung" brakes. The following figures are taken from the tests:

	Air, lbs.	West truck, lbs.	East truck, lbs.
(1) Theoretical	60	9,750	10,360
(2) Standing	60	5,590	4,780
(3) Running	60	8,170	8,380

Comparing lines (1) and (2), it is seen that the theoretical pressure on the wheels on the west truck is less than that on the east, which is caused from the fact that the floating lever was not proportioned to give absolute equalization on both ends. When air is applied and the oil cylinders give the real pressures, we find that the wheels of the west truck get more pressure than those on the east. This is easily accounted for when it is explained that the two additional pieces

of the cylinder rod and floating lever are in the connections to the east truck, and therefore that the larger combination of connections consumes more power than the smaller combination to the other truck. The figures would also indicate that freight brake equipment, which is more roughly put together than passenger, is thus necessarily harder to move while standing, but that when once in motion it receives shaking sufficient to largely overcome the retarding effect of roughness of the joints.

The diagram, obtained by plotting a large number of readings from running tests, shows a result much similar to Mr. Marshall's diagram (Fig. 2, reproduced from our issue of May 3.—Ed.) giving, if anything, lower results, the average obtained being lower than in the example above. Discarding the brakebeam release spring or hangers in both cases, Mr. Marshall's diagram shows that about 75% of the theoretical pressure is obtained on the wheels in passenger service, whereas, the extremes of results obtained by the writer on freight service vary from about 65 to 80% of theoretical brake pressure and give an average on the plotted diagram of about 72%. A few of the results obtained from the tests are given below:

Air. lbs.	Theoretical. lbs.	Actual. lbs.	Per cent. less
55	9,498	7,800	18%
65	11,225	9,000	20%
72	12,427	9,800	21%
78	13,463	10,400	23%
80	13,808	10,000	28%

I fear that too much of your valuable space has been taken up, as this letter is longer than was intended when it was begun. It is hoped, however, that it may induce some one else to discuss the subject.

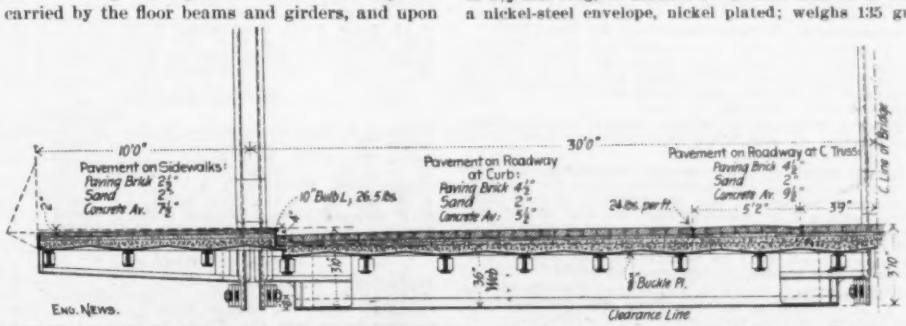
"Pressure."

Chicago, Ill., July 17, 1894.

SOLID FLOOR SYSTEM, FRONT ST. VIADUCT, COLUMBUS, OHIO.*

We illustrate herewith the solid floor system for the Front St. viaduct at Columbus, O. This viaduct is being constructed to carry the street traffic over the tracks of the Pittsburg, Cincinnati, Chicago & St. Louis and Cleveland, Cincinnati, Chicago & St. Louis railways, and consists of two skew spans 161 ft. 6 ins. long each, carrying two roadways, two street railway tracks, and two sidewalks. Each span consists of three trusses placed 30 ft. apart c. to c., and the roadway and street railway tracks are carried between these trusses, with the sidewalks supported by brackets on the outside of the bridge. In addition to the skew of 23° the bridge is 3 ft. higher at the center pier than at the abutments, which necessitated putting the horizontal planes of the end pins of the trusses at different heights from the level bridge seats in order that the curb level on a right angled section might be the same. This change in elevation is effected in the design of the shoes. The entire bridge is of basic open hearth steel, having an ultimate strength of from 54,000 lbs. to 62,000 lbs. per sq. in.

The construction of the floor system is shown by the drawings. A system of steel buckle plates is carried by the floor beams and girders, and upon



SOLID BUCKLE PLATE AND CONCRETE FLOOR, FRONT ST. VIADUCT, COLUMBUS, OHIO.

this is placed a layer of concrete as a foundation for the pavement. The pavement is of brick laid on sand on the concrete. Other details of the construction are shown by the drawings. The bridge was designed by Mr. Jos. Kinnear, City Engineer, Columbus, O., and the contractors for the steel work were the Edge-Moor Bridge Works, of Wilmington, Del. We are indebted to Mr. Kinnear for the drawings from which our illustration has been prepared.

* This article was printed in our last issue, but by mistake its proper cut was omitted, and a cut representing the details of the Providence trough floor, described in an article on the same page as the above, was inserted. We therefore reprint it with the cut belonging to it.

The East River tunnel built by the East River Gas Co. has been completed, having been commenced in 1892. The tunnel is 2,516.4 ft. long, 8½ ft. high by 10 ft. wide, runs under Blackwell's Island and comes out on the New York side at 71st St. The top of the tunnel under the channel on the New York side at the point of nearest approach to the bottom of the river is 40.93 ft. below the river bottom, while under the channel on the Brooklyn side the nearest approach of the top of the tunnel to the river-bed is 82.33 ft. The depth of water in the channel on the New York side is 65 ft. and in the channel on the Brooklyn side is 30 ft. The shafts are each 9 ft. square, the one on the New York shore being 135 ft. deep, and that at Ravenswood being 147 ft. deep. The tunnel under Blackwell's Island goes through solid rock. Under the river it is lined with iron plates surrounded by liquid concrete, which makes a solid bed. It will be used to convey gas to this city from gas works on Long Island. The works was described and illustrated in our issue of March 1, 1894.

A tunnel under the Mississippi River at New Orleans is proposed by G. C. Schulze. It would be just far enough below the surface not to interfere with navigation.

Good progress is being made in the Jeddo mining tunnel at Ebervale, Luzerne county, Pa. Air to run the drills, pumps, etc., is supplied by two Ingersoll-Sergeant "straight line" air compressors, one having cylinders 24 × 30 ins., another, 20 × 24 ins., and a smaller one is held in reserve for emergencies. The following is an extract from a recent communication from the contractors, Chas. F. King & Co., sent to the Ingersoll-Sergeant Rock Drill Co.:

We are doing some tall work in this tunnel, at least we think we are. In the Butler end we cleaned up in May 301½ ft., and in June 305 ft. of heading. At Ebervale heading we cleaned up in May 308 ft., in June 300 ft. You will agree with us that this is exceptionally good work, especially at Butler where the compressed air is carried two miles. We expect to get a hole through about the middle of August. We are driving the tunnel full section 7 × 11 ft., with two 3¼-in. Ingersoll-Sergeant rock drills in each heading, by two shifts of men, each shift working ten hours per day.

The Boston rapid transit law was approved by popular vote on July 24, and is therefore operative. The law grants a franchise to Joe V. Meigs, Thos. W. Hyde, President of the Bath, Me., Iron Works, Theodore W. Myers, of New York, and others for the construction of a system of elevated railways, and also provides for the construction by the city of the Tremont St. subway, under the direction of a commission to be appointed by the Governor.

The competitive test of small arms, which commenced at the Newport Torpedo Station on Aug. 1, has for its purpose the selection of the breech mechanism best adapted to the 6 mm., or .236 in. caliber rifle barrel recently adopted for use in the U. S. Navy. The present navy small arm has the old .45-in. caliber, with an effective range of 1,200 yds., with regulation black powder. The new .236-in. projectile is 1½ ins. long, is made with a hard lead core, with a nickel-steel envelope, nickel plated; weighs 135 grs. and is propelled by 40 grs. of the highest powered smokeless powder known, inclosed in a bottle-shaped case. It has a killing range of 2,000 yds., or 1.13 miles, and each man can carry 150 rounds instead of the 55 rounds of the old .45-in. caliber. As showing how rapidly the large caliber projectiles are becoming obsolete in the world's armies, the following list is given of the projectiles already adopted by the several nations named:

	Mm.	Inches.
Italy, Roumania, Holland	6.5	.256
Spain, Chili; Mauser rifle	7.0	.275
French Lebel rifle	8.0	.315
German Mannlicher rifle	6.5	.256
U. S. Navy	6.0	.236
English, Lee-Metford	7.7	.300
Belgium, Turkey; Mauser rifle	7.65	.298
U. S. Army, Krag-Jorgensen	7.7	.300

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

ATTICA & FREEDOM.—Press reports state that this road has been purchased by S. S. Bullis, Olean, N. Y., and that it will be rebuilt; S. J. Lyke, Attica, superintending the work at the Attica end of the line. The road is 33 miles in length, 3-ft. gage and is laid with 30-lb. rails.

BUFFALO & SUSQUEHANNA.—It was expected to have trains running on this road between Galeton and Ansonia, Pa., 13 miles, by Aug. 1.

BUFFALO, ROCHESTER & PITTSBURG.—This company is reported about to spend between $30,000 and $40,000 in improving the facilities of its shop plant at Bradford, Pa. This includes the building of a trestle and dock for the coaling of engines.

GRAND TRUNK.—Press reports state that this company is building an extension from the Georgian Bay line at Park Head station near Winston, Ont., the terminus of that branch, east to Owen Sound, where it connects with the terminus of another branch of the Grand Trunk that starts from Orangeville, Ont. About 13 miles of road will be built, the contractor being J. C. Boyd, of Simcoe, Ont.

LONG ISLAND.—The contract for the completion of the Port Jefferson extension to Wading River, 12 miles, has been awarded to Hawman Bros., Reading, Pa. Ch. Engr., P. L. Ford, Long Island City, N. Y.

PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS.—The right of way for a belt line four miles in length at Elwood, Ind., has all been obtained and the road will be completed at once, according to reports.

WESTERN MARYLAND.—Press reports state that this company is arranging to complete its extension from York to Chickies, Pa., so as to connect with the Reading system. Prin. Asst. Engr., C. O. Vandervaater, Baltimore.

WISCASSET & QUEBEC.—F. A. Rowe, of Rowe & Hall, contractors for this narrow-gage railway in Maine, is reported as stating as follows: We have 20 miles of grading completed and 40 in process of construction, or all except the last 14 miles at the upper end, which must be first cleared. One large wharf at Wiscasset, which will be our terminus, is completed, and we intend to haul freight from it inside of 10 days. The half-mile of trestle work from the wharf up to the shore is well under way, and will surely be completed by the middle of August. We have had considerable hard work and many cuts, including one in the town of Alna, and the remaining work is very easy, being straight away over level fields.

Projects and Surveys.

LAKE AIOSKAWASTING.—Edwin P. Clark, Kingston, N. Y., and Chas. T. Coutant, St. Remy, N. Y., are reported as interested in a projected railway from Gardiner and New Paltz, N. Y., to the top of Shawangunk Mountains, where it is proposed to establish a summer resort.

Southern—Existing Roads.

CHARLESTON, CINCINNATI & CHICAGO.—A correspondent writes us that this road is graded from Johnson City, Tenn., to St. Paul, Va. The officials are considering a new route which would leave Clinch River at the mouth of Guest River and extend up the latter to Coeburn, Va., then up Big Tom Creek to Tulers Gap and crossing Sandy Ridge to the Big Sandy River, which empties into the Ohio River at Catlettsburg, Ky. A. N. Molesworth, Johnson City, Tenn., is chief engineer.

NASHVILLE, CHATTANOOGA & ST. LOUIS.—The Centreville Branch has been changed to standard gage.

Projects and Surveys.

RAYMOND.—Incorporated in Florida to build a railway six miles in length; capital stock, $20,000; Pres., Cyrus Raymond, Danbury, Conn.; Vice-Pres., H. P. Walker, Auburndale, Fla.

WEST VIRGINIA.—It is stated that a company will soon be chartered by M. Lulaski, Chicago, Ill.; C. A. Lawrence, Fairmont, W. Va.; J. T. McGraw, Grafton, W. Va.; J. P. Clifford and A. G. Smith, of Clarksburg, W. Va., to build a railway from Clarksburg by way of Ten Mile Creek to New Martinsville.

Southwest—Existing Roads.

MISSISSIPPI & LITTLE ROCK.—About 27 miles of this railway is in operation extending west from the St. Louis Southwestern at Aurich, Ark., and it is stated that the necessary funds have been secured for completing the line to Little Rock. Ch. Engr., Jas. A. Martin, Little Rock, Ark.

SAN ANTONIO & GULF SHORE.—Press reports state that S. Massey & Co., Kansas City, have thrown up the contract for building this road after completing about 25 miles of grade and that the work will be continued under the direct charge of the railway company. Ch. Engr., R. H. Gresham, San Antonio, Tex.

HOUSTON, EAST & WEST TEXAS.—This road has been changed to standard gage. The track is all laid and nearly all of the new rolling stock has been received.

Projects and Surveys.

ARKANSAS.—The commercial league of Newport, Ark., has appointed a committee consisting of I. Goldman, L. Minot and W. A. Billingsley to take steps to secure a railway to Bonnerville, a distance of 15 miles.

ARKANSAS, TEXAS & MEXICAN CENTRAL.—Incorporated in Texas to build a railway from near Montague, Tex. (principal office), to Abilene, Tex., on the Texas Pacific, a distance of 15 miles; capital stock, $150,000; A. J. Wolverton, J. A. Bivens, P. M. Devitt, A. L. Matlock, W. Boyce, J. C. Weaver and others.

VICTORIA.—A press report from Robeline, La., states as follows: John R. Jones, of Shreveport, and L. G. Nicholls, of Victoria, and A. W. Estes and Don E. Sorelle, of Many, met here last week and signed the contract for the extension of the Victoria railway to Many. The construction of the road is now a certainty, and there is rejoicing and great satisfaction over this important step.

Rocky Mt. & Pacific—Existing Roads.

ESQUIMALT & NANAIMO.—It is stated that work will be commenced this month on the extension to Comox, 90 miles nearer the northern end of Van-

couver Island. Contracts have been let in five-mile sections. Pres., Alex. Dunsmuir, Victoria, B. C.

SAN PETE VALLEY.—The construction of the extension from Manti to Moroni, Utah, seven miles, was expected to have been commenced this week.

Projects and Surveys.

COLUMBIA RIVER & ASTORIA.—A correspondent writes us that the contract has been awarded to J. J. Shafer, of Chicago, for building this line from Astoria to Goble, Ore., 65 miles, where it will connect with the Northern Pacific. J. C. Stanton, Auditorium Hotel, Chicago, is the promoter. There will be about 15 draw and several smaller bridges. Work is to be commenced about Sept. 1.

SALT LAKE & MERCUR.—Incorporated in Utah to build a standard gage railway from Fairfield, on the Union Pacific, to the Mercur mines, a distance of nine miles; work is to be commenced at once; capital stock, $100,000; Pres., A. A. Noon, Provo; Vice-Pres., J. G. Jacobs, Salt Lake City; Secy. and Treas., J. J. Stewart, Salt Lake City.

Foreign.

INTER-OCEANIC.—The contract for constructing the third section of this Mexican railway is reported to have been awarded to an American syndicate for $1,250,000.

NATIONAL TEHUANTEPEC.—A press report states that this railway has been completed. The line extends from Salina Cruz to Coatzacoalcos, Mex., and is 190 miles in length.

STREET AND ELECTRIC RAILWAYS.

ATHOL, MASS.—The Athol & Orange St. Ry. Co. has been incorported to construct a street railway seven miles long; capital stock, $60,000; Treas. and Clk., W. S. Myrick, Boston.

CONWAY, MASS.—It is reported that the citizens have subscribed $25,000 towards the construction of an electric railway, which is estimated to cost $50,000. Pres., Carlos Batchelder; Treas., W. G. Avery.

NORFOLK, MASS.—The Norfolk Suburban St. Ry. Co. has awarded the contract for building 4½ miles of railway between Readville and Forest Hills to the Worcester Construction Co. at about $100,000.

BROOKLYN, N. Y.—The Coney Island & Brooklyn R. R. Co. has been granted permission to change its motive power from horses to electricity.

WHITE PLAINS, N. Y.—The franchises given to the New York, Mamaroneck & White Plains Electric R. R. Co. and the New York, Elmsford & White Plains Electric R. R. Co. have been declared invalid and it is reported that another company has been formed which will apply for a charter. S. H. Gainsboro is interested.

YONKERS, N. Y.—The Yonkers Electric Ry. Co. has been incorporated to construct an electric railway about ten miles in length; capital stock, $1,000,000; directors, J. I. Burns, W. D. Baldwin, Gelston Affleck, Yonkers; B. L. Rice and C. J. Downing, New York; G. S. Forbush, Brookline, Mass.; G. W. Williams, Bandon, Ore.

CENTERVILLE, PA.—It is reported that Prof. J. C. Ricketts, of Slippery Rock, estimates the cost of building an electric railway from this place to Keister's Station, a distance of three miles, at between $20,000 and $25,000.

JENKINTOWN, PA.—The Philadelphia, Cheltenham & Willow Grove Electric Ry. Co. has awarded the contract for building its line from Rising Sun to this place to William Wharton, Jr. The company is to rebuild the bridges and macadamize the York road, over which the line is to operate.

MOUNT CARMEL, PA.—Surveys have been completed for the construction of an electric railway from this place to Centralia. It is stated that the construction will be commenced early in August.

GREENSBURG, PA.—The Pitcairn, Wilmerding & Braddock St. Ry. Co. has been incorporated to build an electric railway 3½ miles long; capital stock, $21,000; Pres., W. J. K. Kline, Greensburg; directors, G. W. Borrichlow, G. C. Garber and others, Pittsburg.

POTTSVILLE, PA.—The Pottsville, St. Clair & Minersville Electric Ry. Co. is having surveys made for the construction of its proposed line, ten miles long; capital stock, $150,000; Pres., W. S. Sadler, Carlisle.

READING, PA.—The council has been petitioned by S. B. Shepp, Philadelphia, and others, for a franchise for an electric railway in the eastern and northern sections of the city.—A press report states as follows: Contracts have been awarded by the Scranton & Pittston Traction Co. for the building of a trolley line to connect these two cities. Three miles and a half of the line from this city have been built for some time, and the work of constructing the balance of the line will be pushed forward as rapidly as possible. This line is a portion of the electric railway system of the Wyoming and Lackawanna valleys, which, when completed, will be one of the most extensive interurban electric railway systems in the world. About 30 towns and villages are to be connected by trolley with Scranton, Pittston, Wilkes Barre and Carbondale.

WASHINGTON, D. C.—The Washington, Alexandria & Mount Vernon Electric Ry. Co. has been granted a franchise through the Arlington reservation.—The Chevy Chase & Kensington Electric Ry. Co. has been organized; Pres., O. R. Harr; Secy. and Treas., W. H. Walker.—W. B. Upton, Ch. Engr., Columbia R. R., writes us that the company will build 2¾ miles of double track cable railway. E. Saxton has the contract for street work.

WESTMINSTER, MD.—The Westminster & Union Mills Electric Ry. Co. has been organized, with a capital stock of $250,000, by H. T. Shriver, C. E. Stewart, J. L. Reifsnider and others.

CINCINNATI, O.—It is reported that negotiations are being carried on between the Cincinnati Northwestern and the Consolidated St. Ry. Co. for the purchase of the former road by the latter and the changing of it to an electric railway.—The Mt. Auburn Electric Ry. is reported as to be extended.

MIDDLETOWN, O.—The council has adopted a route for an electric railway, and it is stated that bids will soon be asked for a franchise or for the construction.

OSHKOSH, WIS.—J. K. Tillotson, Toledo, O., has taken definite steps toward constructing the electric street railway in this city, for which a franchise was granted some time ago, and arrangements are also being made for a line between this city and Kaukauna, according to reports.

INDEPENDENCE, MO.—It is reported that the Kansas City Cable Ry. Co. is making arrangements to change the motive power of the Rapid Transit division from steam to electricity, at an estimated cost of about $150,000. Pres., Walton Holmes.

ST. LOUIS, MO.—The mayor has signed a bill for the construction of the Southern Electric R. R.

SALT LAKE CITY, UTAH.—It is stated that the Salt Lake City Ry. Co. will probably extend its Waterloo line to Calders Park.

WASHINGTON, IND.—The construction of the Washington St. Ry. Co., noted in our issue of July 12, was commenced July 31. Pres. and Gen. Man., L. C. Fritch, Union Central Station, Cincinnati.

OREGON CITY, ORE.—The council is considering the granting of a franchise for an electric railway to John Myers, Portland, and others.

TORONTO, ONT.—The McCaul St. Ry. Co. has petitioned for a franchise to change its motive power from horses to electricity.

ELEVATED RAILWAYS.

CHICAGO, ILL.—The council has granted a franchise to the Lake St. Elevated R. R. Co. to extend its line a distance of 4,514 ft. to Wabash Ave.

HIGHWAYS.

MASSACHUSETTS.—Bids are asked until Aug. 15 for building a road in the town of Dartmouth, the work consisting of about 2,000 lin. ft. of grubbing and clearing, about 6,000 cy. yds. of rock and earth excavations, 35 cu. yds. of culvert, 107 cu. yds. of rubble bridge, 30 cu. yds. of riprap masonry, and 1,900 cu. yds. of graveling for the roadbed. James E. Allen, Chn. Comrs.—Bids are asked by the commissioners of Middlesex county at East Cambridge, until Aug. 7 for grading the Bedford and Carlisle roads in those towns.

NEW YORK.—Bids are asked by the aqueduct commissioners, 280 Broadway, New York, until Aug. 15 for constructing roads at reservoir D, in Carmel and Kent, Putnam county.

NEW JERSEY.—The freeholders of Morris county, have voted to issue $350,000 in bonds for constructing 182 miles of macadam roads in that county. County Engr., A. E. King, Morristown.

GEORGIA.—The citizens of Chatham county are discussing the question of issuing $500,000 in bonds for improving the county roads.

OHIO.—Bids are asked until Aug. 24 for completing the grading and graveling of the River road for a distance of about 12 miles. Samuel Craig, Engr., Wapakoneta.

INDIANA.—The citizens of Jackson county have voted to gravel the roads from Seymour to Brownstown, Brownstown to Sauer's Church, Medora to Leesville, and Leesville to Sparksville.

WASHINGTON.—The commissioners of Pierce county are trying to have a road constructed into the Pacific forestry reserve, and a petition has been sent to Congress for $15,000 to be used for work on the road inside the reserve.

BRIDGES AND TUNNELS.

BARRINGTON, R. I.—Thos. Kieran, Engr., Fall River, Mass., writes us that the contract for constructing the proposed bridge over Barrington River has been awarded to the Berlin Iron Bridge Co., East Berlin, Conn., at $5,450 or $6,351, according to plan. The bridge will be 20 ft. wide and 350 ft. long. The other bids were as follows:

J. H. Tower, Providence, R. I.	$5,195
Groton Bridge & Mfg. Co., Groton, N. Y.	5,050
Boston Bridge Co., Boston,	$7,100 to 9,100
Dean & Westbrook, New York	7,100
Penn Bridge Co., Beaver Falls, Pa.	4,990
Toledo Bridge Co., Toledo, O.	4,900

ROCHESTER, N. Y.—The council is considering plans for new bridges across the canal at Exchange and Emerson Sts.

SCRANTON, PA.—It is proposed to build a suspension bridge over the tracks of the Delaware & Hudson, Jersey Central, Ontario & Western, and Lackawanna railways, in place of a viaduct, the subject of which has been before the local authorities for some time.

DUNNELLON, FLA.—It is stated that a new railway bridge will soon be built across the Withlacoochee River at this place. The bridge will be of iron or steel and will have a pier in the center of the river with two 60-ft. openings for boats.

TAMPA, FLA.—R. W. Easley, Mayor, writes us that the contract for rebuilding the bridge has been let to J. U. Bryan, Tampa.

HAMILTON, O.—The county commissioners and bridge commission are considering plans for the proposed new bridge. It will probably be a steel plate girder with a 44-ft. roadway and two 10-ft. sidewalks. There will be three piers in the water a distance of 112 ft. 8 ins. apart.—The contract for a bridge over Gregory's Creek, near Le Sourdsville, has been awarded to Patrick Golden, Middletown, at $4,481.

SPRINGFIELD, O.—It is stated that a bridge on the P. & E. division of the Big Four was destroyed by fire July 20.

SIBLEY, IA.—A railway bridge between this city and Ocheyedan was burned July 25.

EAU CLAIRE, WIS.—The bridge on the Omaha railway above Spooner was burned by forest fires July 22, according to press reports.

TOPEKA, KAN.—A correspondent writes us that this city proposes to replace its old bridge over the Kansas River on Kansas Ave. (the main thoroughfare) with a new one of greater width and strength. The present bridge consists of 6 spans, 150 ft. each, which have stood condemned for over 10 years. H. V. Hinckley, Consult. Engr., has completed map, hydrographic data and profile preparatory to calling for designs for the work. John Thomas is chairman of citizens' committee.

OMAHA, NEB.—Bids are asked until Aug. 23 for the construction of a wagon bridge across the Niobrara River near Niobrara. Maj. Chas. F. Humphrey, Ch. Q. M., U. S. A.

NEVADA, MO.—Bids are asked until Aug. 10 for the construction of a small iron bridge. W. H. Wood, Comr.

LANSING, MICH.—Bids were opened July 26 for a bridge over Grand River on Michigan Ave., in place of the present structure, which was built in 1871 at a cost of $10,337. E. O. Sellers, Supt. Pub Wks., writes us that the bridge will be 224 ft. in length and 115½ ft. in width, consisting of two spans of arched girders. The foundations will be cutstone masonry, resting on about 650 piles. Cy Engr., H. D. Bartholomew. The bids, including substructure, superstructure and removal of present bridge, were as follows:

King Bridge Co., Cleveland, O.	$64,050
Variety Iron Works, Cleveland, O.	71,199
Jackson Bridge Co., Jackson, Mich.	67,500
Groton Bridge Co., Groton, N. Y.	71,000
New Columbus Bridge Co., Columbus, O.	72,650
*R. D. Wheaton & Co., Chicago, Ill.	74,000
Massillon Bridge Co., Massillon, O.	73,000
*Geo. H. Davidson, Grand Rapids, Mich.	81,600
Youngstown Bridge Co., Youngstown, O.	65,000
Penn Bridge Co., Beaver Falls, Pa.	75,250
Detroit Bridge & Iron Co., Detroit, Mich.	64,900
*Iron Substructure Co., Columbus, O.	78,000
*Ohio Bridge Co., Toledo, O.	78,600
New Jersey Steel & Iron Co., Trenton, N. J.	70,000
Toledo Bridge Co., Toledo, O.	70,200
*Canton Bridge Co., Canton, O.	72,500
**Wrought Iron Bridge Co., Canton, O.	62,500

* Bids rejected, not being in proper form.
** Awarded contract, subject to approval of the common council.

EL RENO OKLA.—The El Reno Bridge Co. has been incorporated at Guthrie, with a capital stock of $25,000, by W. B. Tryberger, F. E. Gillett and N. Esperson.

WATER-WORKS.

LUDLOW, VT.—The contract for works has been awarded to the Connecticut Pipe Mfg. Co., according to reports; supply from spring.

ST. JOHNSBURY, VT.—The village trustees have contracted with the St. Johnsbury Aqueduct Co. for 20 hydrants for Summerville, a part of the village to which the system will now be extended.

ADAMS, MASS.—An additional supply is reported as necessary.

CAMBRIDGE, MASS.—Bids are asked until Aug. 31 for constructing a reservoir at Payson Park, as stated in our advertising columns. L. M. Hastings, Cy. Engr.

HUDSON, MASS.—E. M. Stowe, Comr., writes us that the town proposes to lay a new main from the pond beside the old main to give increased supply and pressure, but that no specifications have yet been made. Engr., M. M. Tidd, Boston.

LOWELL, MASS.—The council has voted to appropriate $50,000 to continue the experiments with tube wells, upon which about $80,000 has already been expended in securing an additional supply.—Bids are asked until Aug. 9 for constructing a tube well plant, as stated in our advertising columns. Miles E. Brennan, Pres. Bd.

QUINCY, MASS.—The mayor has asked for a further appropriation of $30,000 for extensions.

SALEM, MASS.—The council has appropriated $75,000 for an additional supply, divided as follows: Land damages, $26,000; piping, $36,000; dam and wastewater, $13,000.

SOUTH NORWALK, CONN.—The commissioners have asked for $40,000 for a 6-in. main, and for increasing the storage capacity.

WINSTED, CONN.—Bids are being received for constructing works, according to reports.

COXSACKIE, N. Y.—J. F. Witmer, of Witmer & Voorhees, Engrs., write us that the following bids were received for constructing works, and that the contracts would probably be awarded to T. H. Ryan for the construction, Inman Bros. Construction Co. for pipe, and Kennedy Valve Co. for valves and hydrants:

Work Complete.

Wilde Engineering Co., Valatie, N. Y.	$55,000
H. J. Reilly, New York city	38,000
M. Sullivan, Little Falls, N. Y.	36,046
Oatis & Longyear, Kingston, N. Y.	36,939
Inman Bros. Construction Co., New York.	34,884
W. T. O'Connor & Co., Syracuse, N. Y.	38,113
Lindsay & Van Loon, Plymouth, Pa.	38,400
Joseph Gallio, New York.	35,354
T. H. Ryan, North Tonawanda, N. Y.	31,153
John Marsden, Utica, N. Y.	33,140
Flood & Sherrill, Sandy Hill, N. Y.	38,582
Van Vranken & Duel, Tarrytown, N. Y.	35,431

Pipelaying and Dam.

	Pipelaying.	Dam.
Eldridge & Fogg Const'n Co., N. Y.	$7,993	$5,400
Smith Bros., Pelhamville, N. Y.	10,852	7,500
James Scio & Co., New York	8,498	5,000
W. E. F. Norton, New York	11,156	....
Puglia & Co., Paterson, N. J.	10,116	5,980
P. H. Harrison & Co., New York.	8,806	5,000
E. P. Driesbach, New London, Conn.	8,081	7,000
Ferris & VanKeuren, Jersey City, N.J.	12,200	....
Troy Public Wks. Co., Troy, N. Y.	11,256	10,000

Valves and Hydrants.

Pratt-Cady Co., Hartford, Conn.	$1,595
Michigan Brass & Iron Wks., Detroit, Mich.	1,558
Chapman Valve Co., Boston, Mass.	*1,569
Ludlow Valve Mfg. Co., Troy, N. Y.	1,604
Kennedy Valve Co., Coxsackie, N. Y.	1,515
Eddy Valve Co., Waterford, N. Y.	1,675
Williamsport Valve Co., Williamsport, Pa.	**504
R. D. Wood & Co., Philadelphia, Pa.	1,491

* Does not include the two single gate valves nor valve boxes.
** Valves only.

Cast Iron Pipe.

	Pipe.	Specials.
C. Millar & Son, Utica, N. Y.	$17,892	$285
Radford Pipe Co., Boston, Mass.	18,105	270
McNeal Pipe Co., Burlington, N. J.	18,318	288
Inman Bros. Const'n Co., New York	16,401	270
T. H. Ryan, North Tonawanda, N.Y.	17,040	270

WALTON, N. Y.—The Walton Water Co. is reported as planning to construct a new reservoir.

NEWTON, N. J.—L. L. Tribus, 84 Warren St., New York, has been engaged to design plans for proposed works.

ALLENTOWN, PA.—F. C. H. Schweyer, Seibert & Son, J. B. Stuber, Reinhard & Weaver, and A. M.

Stephens, of this city, and the Standard Construction Co., Easton, have submitted bids for the proposed enlargement of the basin at the works. Only $6,000 has been appropriated, and reports state that the work may cost $18,000.——The council is considering an appropriation of $25,000 for a new main.

CORRY, PA.—C. H. Wetmore has offered to put in works, including 100 fire hydrants, and an electric light plant of 50 arc lights, which shall become the property of the city after 21 years. The council is considering the proposition, which provides for a domestic supply at 6 cts. per 1,000 gallons. Engrs., Potter & Folwell, Pittsburg.

DUNCANNON, PA.—S. B. Schiller, Ch. Burgess, writes us that the Front Run Water Co. has been organized to put in works; supply from Front Run on Cove Mountain, two miles distant; Pres., John Wister; Secy., W. L. Coover; Treas., P. F. Duncan.

HOMESTEAD, PA.—The citizens have voted to issue bonds for $30,000, including $19,000 for a site for a reservoir and $3,000 for extensions.

MACUNGIE, PA.—Bids are asked for pipe, valves, etc., for the proposed new works. John Erdman, Secy. Council, writes us that the engineering contract has been awarded to L. S. Jacoby, Allentown.

McKEESPORT, PA.—Emanuel Wolf, Secy., writes us that the commissioners have asked for permission to buy two small pumps for the new drive wells.

McDONALD, PA.—Potter & Folwell, Engrs., Pittsburg, write us that the following bids were received for trenching and pipelaying, average haul 2½ miles; the quantities being 41,380 ft. of 10-in. pipe, 1,720 ft. of 8-in., 6,570 ft. of 6-in., 6,315 ft. of 4-in., 40 hydrants, 32 valves:

McConegley & Sons	$14,734
Wilson, Smith & Coon, Sharpsburg, Pa.	14,729
B. M. Poland & Co., Pittsburg, Pa.	23,822
P. J. Flynn, Allegheny, Pa.	15,850
T. A. & R. G. Gillespie, Pittsburg, Pa.	14,559
William Pickett, Little Washington, Pa.	(informal)
L. G. Hallock, Wheeling, W. Va.	15,129
Cronin & O'Herron, Pittsburg, Pa., (aw'd con't).	14,220
P. O'Donnell, Pittsburg, Pa.	24,354
W. H. Roberts, Pittsburg, Pa.	21,838
Curran & Hussey, Pittsburg, Pa.	32,066
McCann & O'Brien	19,224
Chandley Bros., Beaver Falls, Pa.	19,424
Lewis & Lawler, Pittsburg, Pa.	14,615
W. M. Chisholm	17,780

MEADVILLE, PA.—The ordinance authorizing an issue of $75,000 in bonds for works has passed two readings in the council.

NORTHUMBERLAND, PA.—The contract noted in our issue of July 19 as awarded to A. M. Thomas, Lock Haven, has been relet to Miller & Mussina, Lock Haven.

OIL CITY, PA.—Bids are asked until Aug. 4 for the construction of two steel tanks of 8,000 bbls. capacity each, on Hanson Heights. A. M. Breckinridge, Clk.

RED LION, PA.—It is stated that new works will be put in by the water company.

ABERDEEN, MD.—Bids are asked until Aug. 15 for constructing works, as advertised in our proposal columns. Engr., C. M. Johnson, Baltimore. J. A. Swingley, Secy.

SNOW HILL, MD.—Bids will soon be asked for works, according to reports.

WASHINGTON, D. C.—Bids are asked by the district commissioners until Aug. 11 for a supply of cast iron pipe, as stated in our advertising columns.

RONCEVERTE, W. VA.—Voorhees & Witmer, Buffalo, N. Y., have been engaged to prepare plans for works.

AUGUSTA, GA.—It is expected that the council will take action this month on proposed improvements estimated to cost $150,000.

ELBERTON, GA.—W. B. Henry, Clk. Council, writes us that surveys have been made for works and electric lights, but that no other steps have been taken.

THOMASTON, GA.—There is talk of works, the proposed supply being by gravity from springs seven miles distant.

UNION SPRINGS, ALA.—An 8-in. well is being sunk and it is reported that a stand-pipe and works will be put in.

BELOXI, MISS.—Phil McCabe, Cy. Clk., writes us that the water company has secured a temporary injunction restraining the city from securing other works; case to be tried early this month.

OXFORD, MISS.—Bids are asked for a franchise for works, according to reports. Ed. O. Davidson, Secy. Bd. of Aldermen.

AUDUBON, KY.—Subscriptions are being secured for putting in works for fire protection; supply from the Henderson mains. Address J. L. Boswell.

MORGANFIELD, KY.—Bids are asked until Aug. 20 for constructing works, as stated in our advertising columns. Engrs., Sanders & Porter, Louisville. H. X. Morton, Secy. Com.

ATTICA, O.—L. L. Sutton, Clk. W. W. Trustees, writes us that bids will probably be asked this month for new works estimated to cost $15,000. Work will include wells to be sunk through bed of quicksand and 12 × 80-ft. steel stand-pipe. The engineering contract will be let within a few days.

BOWLING GREEN, O.—The water company is reported as about to sink more wells and put in deep-well pumps.

CLIFTON, O.—Bids are asked until Aug. 18 for the purchase of $2,000 of 4½% 30-year water extension bonds. S. G. Sterling, Clk.

LORAIN, O.—The Johnson Co. is reported to have made a proposition to the trustees whereby it is to lay 18,000 ft. of 12-in. and 14,000 ft. of 6-in. pipe, at a cost of about $28,000, and the trustees will spend $8,000 for a new boiler and repairs at pumping station; the work to be commenced at once.

NAPOLEON, O.—J. B. Strawn, Engr., Salem, O., writes us the following bids were received for constructing the proposed water-works and electric light plant: Toledo Construction Co., for combined plant, $47,000; water-works only, $35,000; Chandley Bros. & Co., Beaver Falls, Pa., water-works, $38,700; with Corliss engines for both water-works and electric lights, but not including electrical part, $45,200; Geo. C. Morgan, Chicago, water-works, $43,975; Arbuckle-Ryan & Co., Toledo, O., water-works, $46,942; Shaw-Kendall Co., Toledo, O., combined plant, $56,276; water-works only, $42,880; Sykes & Wagner, Minneapolis, combined plant, $49,330. For pumping machinery the following parties submitted bids: Deane Steam Pump Co., Holyoke, Mass.; Henry R. Worthington, Laidlaw-Dunn-Gordon Co., Cincinnati; Barr Pumping Engine Co., Philadelphia; Stilwell-Bierce & Smith-Vaile Co., Dayton, O.; John McGowan; Stephens & Bedwards, Logansport, Ind. For fire hydrants.—Ludlow Valve Mfg. Co., Troy, N. Y.; Geo. C. Morgan, Chicago; J. B. Clow & Son, Chicago; Chapman Valve Co., Indian Orchard, Mass.; Tamaqua Mfg Co., Tamaqua, Pa.; R. D. Wood & Co., Philadelphia; Bourbon Copper & Brass Wks., Cincinnati; Crane Co., Chicago. Valves.—Ludlow, Geo. C. Morgan, J. B. Clow & Son, Rensselaer, Chapman, Eddy, Crane, Bourbon. Pipelaying.—Stephens & Bedwards, Logansport, Ind.; Geo. C. Morgan, Chicago; Martin & McNamara, Washington, D. C.; Chas. H. Brayman, and Geo. W. Townsend, of Toledo. Standpipe.—Enterprise Boiler Co., Youngstown, O.; Stephens & Bedwards, Logansport, Ind.; Armstrong Bros., Springfield, O.; Munroe & Son, Pittsburg; Cunningham Iron Wks., South Boston, Mass.; Brownell & Co., Dayton, O. Boilers.—Erie City Iron Wks., Erie, Pa.; Armstrong Bros., Springfield, O.; Munroe & Son, Pittsburg; Geo. N. Crawford & Co., Chicago; Brownell & Co., Dayton, O.; Phoenix Iron Wks., Meadville, Pa.

NORWOOD, O.—The citizens have voted to issue $50,000 additional water bonds.

SPRINGFIELD, O.—Bids are asked by the water-works trustees until Aug. 14 for constructing wells, engine house, and furnishing and laying 300 ft. of 36-in. light cast iron pipe, as stated in our advertising columns. Consult. Engr., J. D. Cook, Toledo.

AURORA, IND.—Alexander Potter, New York, was in the city last week making surveys for works, according to press reports.

CAMBRIDGE CITY, IND.—At an election July 24 the citizens voted to put in works, at an estimated cost of $25,000.

GOSHEN, IND.—The commissioners are considering plans for increasing the supply. New boilers will be required and new works may be built in the southern portion of the city.

HARTFORD CITY, IND.—The city is reported to have decided to grant a franchise.

DETROIT, MICH.—The park board is having plans prepared for a general water system on Belle Isle.

KALAMAZOO, MICH.—The committee has been authorized to make 8,700 ft. of extensions, to cost about $5,000.

ONTONAGON, MICH.—The contract for works has been awarded to Fairbanks, Morse & Co., St. Paul, at $22,480; Engr., Chas. F. Loweth, St. Paul. The other bids for the complete work were as follows

Million & Young, St. Paul	$23,950
E. T. Sykes, Minneapolis	25,400
U. S. Wind Engine Co., Batavia, Ill.	25,906
Geo. R. King & Co., Duluth	27,390
Kirkland & Starkey, St. Paul	27,566

OXFORD, MICH.—The city is reported as investigating the cost of works.

AURORA, ILL.—Bids are asked until Aug. 4 for the purchase of $30,000 in 5% water-works bonds. J. M. Kennedy, Cy. Clk.

DAKOTA, ILL.—The citizens are reported as agitating the question of works.

JOLIET, ILL.—The council has contracted with W. H. Gray & Bro., Chicago, to deepen several artesian wells, now 1,100 to 1,200 ft. deep, to a depth of 1,600 ft. at $2 per ft., according to press reports.

LEXINGTON, ILL.—The citizens have voted to issue $7,500 in bonds for works and it is stated that a contract will soon be awarded for a brick and stone stand-pipe 105 ft. high. A. B. Davidson, Cy. Clk.

LINCOLN, ILL.—The "Courier" urges that an engineer be employed to make estimates for new works.

MARSHALL, ILL.—The proposition to issue $32,000 in bonds for works was defeated July 20.

MOLINE, ILL.—The council has sold $50,000 in water bonds and has voted to lay 16,131 ft. of mains. Chas. G. Carlson, Cy. Clk.

O'FALLON, ILL.—The O'Fallon Electric Light, Power, Heat & Water Co. has been incorporated, capital stock $20,000, by S. C. Smiley, E. Tiedeman, Phillip Hehde and Joseph Porter.

ROSSVILLE, ILL.—S. W. McGuire, Village Clk., writes us that a committee was appointed July 25 to secure plans and specifications for works to cost $5,000.

VANDALIA, ILL.—An election will be held Aug. 14 to vote on the question of works.

ANTIGO, WIS.—Fred Hayssen, Cy. Clk., writes us that the council is considering the purchase of the works.

COLUMBUS, WIS.—There is talk of putting in works.

LODI, WIS.—The council has been petitioned to investigate the question of works.

NEILLSVILLE, WIS.—A supply from springs, with a reservoir, is being considered, instead of the present supply from a creek. J. W. Hommel, Comr.

SKULLSBURG, WIS.—An election will be held Aug. 20 to vote on an appropriation of $8,000 for works.

BELLEVUE, IA.—The contract for constructing works except pipelaying, has been awarded to the Dubuque Construction Co., Dubuque, at $11,693; M. Tschirgi, Engr. The contract for pipelaying was awarded to the Haney & Campbell Mfg. Co., Bellevue, at $1,756.

ALTON, IA.—A. A. Richardson, Lincoln, Neb., has been engaged to design plans for works.

MARENGO, IA.—The citizens have voted to issue $8,000 in bonds for works.

OAKLAND, IA.—Works will be put in, according to press reports.

PERRY, IA.—An explosion of a boiler in the pumping station and electric light plant, July 24, destroyed the building and seriously injured the engineer.

ROLFE, IA.—The city has voted to issue $10,000 in bonds for works.

SCHALLER, IA.—A proposition to issue bonds for works was voted upon July 30.

ECHO, MINN.—The contract for works has been awarded to Tobin, Gleason & Smith, Minneapolis, at $5,000, according to reports.

MINNEAPOLIS, MINN.—F. W. Cappelen, Cy. Engr., is investigating the subject of filtration with reference to the supply from the Mississippi River, and will probably report to the council very soon.

SLAYTON, MINN.—An election will soon be held to vote on an issue of $10,000 in bonds for works, according to reports.

BEATRICE, NEB.—The Cook Well Co., St. Louis, is investigating the question of a supply.

BLAIR, NEB.—Bids are asked until Aug. 10 for pump house, 1,000,000-gallon pumping engine, tubular boiler, etc., as stated in our advertising columns. Engr., F. L. Burrell. C. Schmachtenberg, Cy. Clk.

HUMPHREY, NEB.—A. A. Richardson, Engr., Lincoln, writes us that owing to a technicality the issue of bonds will have to be voted upon again and the opening of bids has been postponed from Aug. 15.

PENDER, NEB.—The contract for works has been awarded to Goodrich & Robinson, at $8,400.

SYRACUSE, NEB.—An election will be held Aug. 13 to vote on an issue of bonds for works. Engr., A. A. Richardson, Lincoln.

MINOT, N. DAK.—H. B. Mann, Cy. Audr., writes us that the contract for constructing works has been awarded to Jas. H. Scofield, Minot, at $6,800.

VERMILLION, S. DAK.—The water company has been unable to agree upon terms with the council and the works have been permanently closed, according to press reports.

GENESEE, IDAHO.—The city has voted to issue $13,500 in bonds for works, and it is stated that the construction will soon be commenced.

GLASGOW, MO.—The contract for works has been awarded to Jaeger & Blanchard, Rice Hill, Mo., at $6,350.

KAHOKA, MO.—The city is reported to have raised $3,700 toward building works.

NEWPORT, ARK.—The water company is reported as negotiating for a steel stand-pipe.

DALLAS, TEX.—Bids are asked until Aug. 10 for furnishing 24 fire hydrants, with full 6-in. flow, 6-in. connections 3 ft. from center of inlet to pavement, with one steamer and two hose connections. J. M. Strong, Supt. W. W.

OAK CLIFF, TEX.—Bids are asked until Aug. 10 for a 14 × 18-ft. stand-pipe, 35 hydrants, 300 tons of pipe, etc. Engr., J. S. Thatcher, Dallas. J. W. Roach, Chn. Com.

ASTORIA, ORE.—A new pumping station is to be constructed, according to reports.

SAN LUIS OBISPO, CAL.—The city attorney has reported that the water company has no exclusive franchise and there is talk of new works.

MONROVIA, CAL.—Joe Comly, Supt., writes us that the city will spend $40,000 this year and next developing water in the mountains. The city uses cement pipes for irrigation and 4 and 6-in. iron pipe for fire and domestic purposes. It has two cement-lined reservoirs and will build an additional one. Population, 1,200.

PICTOU, N. S.—Bids are asked until Aug. 6 for furnishing a supply. F. Mackaracher, Town Clk.

BRACEBRIDGE, ONT.—Bids were asked until July 31 for the purchase of $25,000 in 5% 30-year water and electric light bonds. A. Hunt, Mayor.

PORT HOPE, ONT.—An election was held July 31 to vote on an issue of $30,000 in bonds for extending and improving the works.

ARTESIAN WELLS.

CASTALIA, S. DAK.—A press report states that this (Charles Mix) county will soon hold an election under the natural water course act of 1893 to vote on the question of sinking artesian wells. It is expected the proposition will carry by a good vote and the sinking of the wells begin as soon as contracts can be made. The present proposition contemplates the sinking of 11 wells at an average cost of $4,000 per well.

IRRIGATION

GERING, NEB.—A press report states that it is proposed to extend the Mitchell canal about 15 miles and enlarge it to carry much more water. The canal will have to cross the bad lands. This has been the obstacle which has heretofore prevented the irrigation of one of the finest valleys along the river. A preliminary survey was made last week, however, which shows that the object can be accomplished at a cost of about $75,000, and as a large proportion of this estimate is provided for in the labor which will be performed by the land owners, it is being very strongly agitated. The extension will make the Mitchell canal almost 50 miles in length.

VENTURA, CAL.—The Saticoy Irrigation Co. has been organized at Saticoy and is having surveys made from the Sespe to near the Ventura city limits, some 30 miles, according to reports. A pipe line will be laid the entire distance, the water supply to come from the Santa Clara, Santa Paula and Sespe streams.

NEW COMPANIES.—Barton Pipe Line & Water Co., Barton Ranch, San Bernardino county, Cal.; $11,800; W. A. Nichols, Edw. Quine, B. G. Burdick, W. J. Melville, S. A. Grover and others, of Redlands.——Pasadena Park Tract Land & Water Co., Pasadena, Cal.; $240,000; J. B. Young, R. F. Ball, P. M. Green, of Pasadena; J. R. Boaland, J. B. Newton, of Los Angeles.——Bessemer Irrigating Ditch Co., Pueblo, Colo.; $200,000.

SEWERS.

ROCHESTER, N. H.—Bids are asked until Aug. 11 for constructing brick and pipe sewers; also for sewer materials, as stated in our advertising columns. Engr., E. W. Bowditch, 60 Devonshire St., Boston. C. S. Barker, Chn. Com.

MIDDLEBURY, VT.—The citizens have voted to issue bonds for constructing sewers in two streets; estimated cost, about $3,500.

RUTLAND, VT.—The council has instructed the committee to advertise for bids for constructing 2,900 ft. of 36-in. brick sewer in Meadow St., and it is proposed to appropriate $10,000 for the construction.

BOSTON, MASS.—Bids are asked by the metropolitan sewerage commissioners until Aug. 11 for building a sewage pumping station at Charlestown. H. A. Carson, Ch. Engr.

GREENFIELD, MASS.—F. M. Thompson, Chn. of

Selectmen, writes us that $12,000 has been appropriated for building sewers. The city will do part of the work, and the remainder will be done by contract.

LOWELL, MASS.—The council has passed resolutions for constructing sewers in five streets.

NATICK, MASS.—It is stated that the construction of the proposed system, noted July 19, will soon be commenced. Riley Pebbles, Chn. Com.

PAWTUCKET, R. I.—The council has passed ordinances for constructing sewers in six streets, and it is proposed to build sewers in five other streets.

ALBANY, N. Y.—Bids are asked until Aug. 6 for constructing 24 to 6-in. pipe sewers in two streets. T. J. Lanahan, Clk.

BROOKLYN, N. Y.—Bids are asked until Aug. 9 for constructing a sewer in Monitor St. A. T. White, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids are asked until Aug. 14 for constructing 30 to 21-in brick sewers in two streets, and 15 to 10-in. pipe sewers in three streets. R. G. Parsons, Secy. Dept. Pub. Wks.

LAKE PLACID, N. Y.—This place has been authorized to issue $9,000 in bonds for constructing a system.

MEDINA, N. Y.—The construction of 2,000 ft. of 18-in. pipe sewer in Main St. has been decided upon; average cut, 12 ft.

NEW YORK, N. Y.—Bids are asked by the department of public works until Aug. 8 for sewer work in 11 streets.

NORTH TONAWANDA, N. Y.—The board of health is reported as discussing a plan for constructing a trunk sewer from Ellicott Creek to the Niagara River, a distance of about a mile, estimated to cost $75,000. If this is not decided upon the state will be petitioned for an appropriation of $10,000 for cleaning the State Ditch.

PLAINFIELD, N. J.—Bids will be asked next week for constructing the following pipe sewers, recently described, the work including 65 manholes:

Size, ins.	Depth, ft.	Length, ft.
24	5 to 14	3,645
18	9½ " 12½	3,778
15	7½ " 14	6,131
12	4½ " 13	7,177
10	6 " 11½	2,427
8	6 " 9	10,665
Total		33,823

EMPORIUM, PA.—The council has been petitioned to construct 7,000 ft. of 20 to 12-in. pipe sewers.

PITTSTON, PA.—It is reported that the council is discussing the question of granting a franchise to a local company to put in a system.

CHARLOTTESVILLE, VA.—The lowest of 17 bids received for constructing the proposed sewers was that of Vaughan & Luck, Roanoke, at $27,707. The itemized bids will be published in a later issue. N. Wilson Davis, Engr.

CHARLESTON, W. VA.—It is reported that this city has sold $50,000 of sewer and street improvement bonds for $52,000.

CHARLESTON, S. C.—R. F. Hartford, Atlanta, Ga., is preparing plans for a system and it is reported probable that a large portion of the system will be built this winter. Consult. Engr., Samuel M. Gray, Providence, R. I.

ALLIANCE, O.—Bids are asked until Aug. 11 for constructing 8,360 lin. ft. of 15 to 6-in. pipe sewers. Thomas Casselman, Cy. Clk.

CLEVELAND, O.—Bids are asked until Aug. 22 for repairing and reconstructing the outlet sewer in East Madison Ave. J. H. Farley, Dir. Pub. Wks.

DAYTON, O.—The contract for constructing sewers in districts 2 and 4 has been awarded to Ware & Moodie at $12,565. F. M. Turner, Cy. Engr.

FOSTORIA, O.—Bids are asked until Aug. 10 for constructing sewers in two districts. R. W. Lysle, Cy. Engr.

MARIETTA, O.—Bids are asked until Aug. 25 for constructing sewers in sewer district No. 2. L. Mueller, Cy. Clk.

TOLEDO, O.—Bids are asked until Aug. 6 for constructing 24 to 20-in. brick sewers in four streets. L. P. Harris, Cy. Clk.

ANN ARBOR, MICH.—G. F. Key, Cy. Engr., has made plans for 11,150 ft. of 10 to 4-in. pipe sewers for district No. 1, depth 6 to 12 ft., estimated cost $6,300. Plans will be ready within a few days for sewers in district No. 2.

HUNTINGTON, IND.—Bids are asked until Aug. 13 for constructing a 12-in. pipe sewer in Jefferson St. H. H. Wagoner, Cy. Engr.

URBANA, ILL.—The Dubuque Construction Co., Engr., M. Tschirgi, has been awarded the contract for a complete system, at $7,337.

GRASS VALLEY, CAL.—It is reported that this place is investigating the cost of a system.

SAN FRANCISCO, CAL.—An appropriation of $18,360 has been made to the Mission Overflow Association for constructing a sewer in 14th St. A. P. Van Duser is reported as stating that the contract will be awarded as soon as right of way can be secured.

SALT LAKE CITY, UTAH.—The board of public works has purchased 75 acres of land which will be used as an outlet for the gravity sewer.

STREETS.

BOSTON, MASS.—Bids are asked until Aug. 7 for building a telford macadam road in Parker St. from Huntington to Westland Aves. H. H. Carter, Supt. of Sts.

BROOKLINE, MASS.—The selectmen are discussing the construction of a boulevard 75 ft. wide and half a mile in length, estimated to cost for construction alone $35,000 to $40,000.

BRIDGEPORT, CONN.—The board of public works has voted to pave Main St. with Trinidad Lake asphalt.

ALBANY, N. Y.—Bids are asked until Aug. 6 for paving with brick and granite blocks. T. J. Lanahan, Clk. Bd. of Contract.

NIAGARA FALLS, N. Y.—The council is discussing the proposed paving of Falls St.

TROY, N. Y.—Bids are asked until Aug. 10 for paving in State St. with asphalt. E. O. Ross, Secy. Comptroller's Office.

CAMDEN, N. J.—The United Towns Improvement Co. has been incorporated, with a capital stock of $10,000, to construct roads, bridges, laying pipes and building street railways; incorporators, H. L. Smith, John Zimmerman, Stratford; G. A. Aldrich, Audubon; Oscar Twitchell, Haddonfield; W. G. Heaney, Philadelphia.

JERSEY CITY, N. J.—Bids are asked until Aug. 6 for paving five streets with asphalt. G. T. Bouton, Clk. Bd. of Comrs.

WASHINGTON, D. C.—The Columbia Concrete Construction Co. has been incorporated with a capital stock of $200,000. Samuel Brent, Alexandria, Va., is attorney for the company.——The engineering department is preparing plans for paving 12 streets.

BALTIMORE, MD.—Bids are asked until Aug. 10 for 3 ft. open-stone gutters in Gay St. A. E. Smyrk, Cy. Comr.

LAUREL, MD.—Bids are asked until Aug. 13 for grading and macadamizing 4,000 lin. ft. in Washington Ave. and building brick sidewalks. G. W. Bond, Clk.

MARTIN'S FERRY, W. VA.—The citizens have voted to issue bonds for public improvements.

ATLANTA, GA.—The Atlanta Chert Paving Co. has been incorporated by J. J. Lyell, Joseph Lambert and George Ware, with a capital stock of $30,000.

CINCINNATI, O.—Bids are asked by the board of administration until Aug. 23 for constructing and repairing artificial stone sidewalks in the eastern and western districts of the city for one year.

KENTON, O.—The council has voted to pave West Franklin St. and to improve three other streets.

LORAIN, O.—The citizens have petitioned the council to pave Broadway with brick, at an estimated cost of $35,000.

MILFORD, O.—The council has decided to advertise for bids for constructing sidewalks in three streets and for grading one street.

TOLEDO, O.—Bids are asked until Aug. 20 for paving Euclid Ave. with Trinidad Lake asphalt, brick or Hallwood blocks. L. P. Harris, Cy. Clk.

HUNTINGTON, IND.—Bids are asked until Aug. 14 for constructing brick or cement sidewalks in 12 streets. Wm. Schwartz, Cy. Clk.

KALAMAZOO, MICH.—The council has adopted an ordinance for paving Burdick St.; estimated cost, $4,590.

QUINCY, ILL.—The council has adopted ordinances for improving three streets, at an estimated cost of $32,033.

MARINETTE, WIS.—It is stated that this city will spend $12,000 for street paving this season.

ELECTRIC LIGHT AND POWER.

WAKEFIELD, MASS.—The council has voted to issue $180,000 in bonds, of which $144,000 is for the purchase of the Citizens' Gas & Electric Co.'s plant and $36,000 for improving and enlarging the plant.

CHERRY CREEK, N. Y.—It is reported that the question of electric lights is being discussed.

COXSACKIE, N. Y.—An application has been made for a franchise for electric lighting.

ALLEGHENY, PA.—The council has voted to advertise for bids for the machinery for an electric light plant.

GILBERTON, PA.—The council is making arrangements to erect a municipal electric light plant. At present the village gets its light from Frackville.

SHICKSHINNY, PA.—It is reported that $8,000 in bonds will be issued for an electric light plant.

TREMONT, PA.—The council has granted a franchise to the Pine Grove & Tremont Electric Light, Heat & Power Co.

ROME, GA.—It is reported that a company, including J. B. Hargrove, T. F. Howell and J. W. Rounsaville, is making arrangements to develop the water power of the Etowah River for the purpose of furnishing electricity for this city.

HARTWELL, O.—A company is reported as being formed with a capital stock of $20,000 for the purpose of supplying this village with electricity. W. S. Waddell, Mayor, is interested.

NAPOLEON, O.—J. B. Strawn, Engr., Salem, O., writes us that bids were received from the following parties for steam engines for the electrical part of the proposed combined electric light and water-works plant: Erie City Iron Wks., Erie, Pa.; Buckeye Engine Co., Salem, O.; Ball Engine Co., Erie, Pa.; Geo. N. Crawford & Co., Chicago; Phoenix Iron Wks., Meadville, Pa.; F. R. Dravo & Co., Pittsburg, Pa., submitted bids for "Nordberg Corliss" engines arranged for operating pumps and electric lights singly or combined. For the electrical part of the plant bids were received from the Fort Wayne Electric Corporation, Fort Wayne, Ind.; Western Electric Co., Chicago; Commercial Electrical Engineering Co., Detroit; General Electric Co., Cincinnati; Westinghouse Electric Mfg. Co., Pittsburg, Pa.; National Electric Co., Eau Claire, Wis.

CHICAGO, ILL.—The Mutual Electric Light & Power Co. is soon to build a plant at 64th court and Wallace St. The buildings and machinery will cost about $40,000, according to reports.

HARLEM, ILL.—The Seckner Contracting Co., Unity Bldg., Chicago, has been awarded a contract for putting in a complete arc electric lighting plant, at $9,709. There will be two 50-light dynamos, a 100-HP. engine, boiler, etc.

ESTHERVILLE, IA.—Bids are asked until Aug. 23 for constructing an electric light plant, as stated in our advertising columns. N. B. Egoert, Cy. Clk.

FORT DODGE, IA.—An exclusive franchise for 25 years has been granted to S. T. Meservey for electric lighting and for a street railway.

MARION, IA.—A 25-year franchise has been granted to A. L. Daniels for an electric light plant.

PERRY, IA.—The electric light plant was destroyed by the explosion of a boiler on July 24. Loss, $12,000.

GRAND ISLAND, NEB.—The council is reported as investigating a system of electric lights to be used in connection with the city water-works plant. It is estimated that an arc and incandescent plant sufficient for the city and public lighting can be added to the present water system for $7,000.

ALAMEDA, CAL.—The board of public works has passed a resolution asking for bids for an electric light plant. The city electrician estimates that the present plant could be exchanged for a more complete system furnishing 100 arc and 1,000 incandescent lights at an estimated cost of about $8,000.

TORONTO, ONT.—Bids are asked until Sept. 1 for the construction of a municipal electric light plant; also for lighting the city for five years, as stated in our advertising columns. W. T. Stewart, Chn. Com.

TRENTON, ONT.—Bids are asked until Aug. 15 for erecting an electric light plant, also for lighting the town. George Crowe, Chn. Fire Com.

NEW COMPANIES.—The Arkansas Valley Electric Co., Florence, Colo.; $50,000; J. W. Stearns, Jr., G. A. Goddard, J. A. Johnson, Denver. —— Vanderwerken, Rickerson & Brainerd Co., New York and Brooklyn, N. Y.; $20,000; manufacturing electrical apparatus; Alfred Vanderwerken, C. L. Rickerson, H. J. Brainerd. ——St. George Electric Co., Ltd., St. George, N. B.; $5,000; T. H. Eastabrooks, A. P. Barnhill, St. John; A. T. Dunn, Musquash.——St. George Electric Light & Power Co., St. George, N. B.; $5,000; J. S. Clark, Timothy O'Brien, H. J. Taylor.——Cincinnati Electric Service Co., Cincinnati, O.; $10,000; M. T. Corcoran, W. B. Cullett, J. F. Dougherty.——Norwood Construction & Electric Co., Chicago, Ill.; $20,000; E. D. Smith, N. Sampson.——The O'Fallon Electric Light, Power, Heat & Water Co., O'Fallon, Ill.; $20,000; S. C. Smiley, E. Tiedeman.——Portable Electric Light & Power Co., Orange, N. J.; $100,000; manufacture electric lamps, motors, etc.; H. C. Douglass, East Orange; Edward S. Darpton, Fred. Cook, Orange. ——Clearfield Traction Co., Philipsburg, Pa.; $10,000; to manufacture cables, motors, and electrical machinery; E. S. Doud, Hazleton.——Lackawanna Valley Traction Co., Scranton, Pa.; $400,000; manufacturing cables, motors, electrical machinery; Treas., R. C. Adams.——Citizens' Light & Ice Co., Woodbury, N. J.; $50,000; R. S. Clymer, D. V. Packer, C. G. Abbott, Woodbury; F. D. Springer, Bridgeport, N. J.; E. B. Williams, Philadelphia, Pa.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

FIRE ENGINE.—Dubuque, Ia.—Bids are asked until Aug. 14 for a new steam fire engine of 800 gallons capacity. T. J. Cooney, Cy. Recdr.

RIVER BANK.—Sunbury, Pa.—The citizens have voted to issue $10,000 in bonds for a river bank along the Susquehanna River as a protection against floods.

DAMS.—San Francisco, Cal.—Bids are asked until Aug. 20 for building wing dams at Heacock Shoals in the Sacramento River. Maj. W. H. Heuer, U. S. Engr. Office.

BOILERS.—Toledo, O.—Bids are asked until Aug. 13 for two high-pressure tubular boilers of 80 HP. each for the Lucas county infirmary. Chas. H. Jones, County Audr.

COURT HOUSE.—Bayfield, Wis.—Bids are asked until Aug. 15 for the construction of a county court house. Archs., Orff & Joralemon, Minneapolis. John Froseth, County Clk.

DREDGING.—Wilmington, N. C.—Bids are asked until Aug. 25 for dredging at Ocracoke Inlet, as stated in our advertising columns. Maj. W. S. Stanton, U. S. Engr. Office.

NATURAL GAS IMPROVEMENTS.—Pittsburg, Pa.—The Equitable Natural Gas Co. is putting in four large pumps and will lay 20 additional miles of small pipe this fall, according to reports.

BUILDINGS.—Ames, Ia.—Bids are asked until Aug. 14 for constructing a ladies' hall and experiment barn at the agricultural college. Arch., Clinton Nourse, Des Moines. E. W. Stanton, Secy.

REMOVING WRECK.—Boston, Mass.—Bids are asked until Aug. 28 for the removal of the wreck of schooner "Ocean Eagle," off Newburyport harbor. Lieut.-Col. S. M. Mansfield, U. S. Engr. Office.

DISINFECTING PLANT.—Washington, D. C.—Bids are asked until Aug. 24 for a disinfecting plant for the quarantine station at Port Townsend, Wash. Jeremiah O'Rourke, Supervising Arch., Treasury Dept.

STEEL TANKS.—Savannah, Ga.—Bids are asked until Aug. 10 for the erection of two steel tanks of 5,000 to 6,000 bbls. capacity each for the storage of spirits of turpentine. Address Savannah Tank & Supply Co.

DIKE.—Celina, O.—The state canal commission and board of public works were in the city recently investigating the proposed dike contemplated in the Glendening law passed last winter. The work will cost $10,000.

PLANS FOR JAIL.—Waukegan, Ill.—Architects are asked to submit plans Aug. 20 for a sheriff's residence and jail; building to be of stone and brick, three stories high, and to accommodate 50 to 75 prisoners. A. L. Hendee, Clk. Lake County.

CANAL, ETC.—Chicago, Ill.—Bids are asked until Aug. 27 for constructing four miles or less of the Illinois & Mississippi Canal, near Bureau Junction, and for excavating the lock pits and constructing the foundations for four locks, as stated in our advertising columns. Capt. W. L. Marshall, U. S. Engr. Office.

CEMENT.—Atlanta, Ga.—Bids are asked until Aug. 6 for furnishing the city 12,000 bbls. of cement. D. G. Wylie, Comr. Pub. Wks.

Pittsburg, Pa.—Bids are asked until Aug. 20 for 2,250 net tons of American natural hydraulic cement, as stated in our advertising columns. Capt. R. L. Hoxie, U. S. Engr. Office.

CONTRACT PRICES.

ASPHALT AND SCORIA BLOCK PAVING.—Hamilton, Ont.—The contract for paving King and James Sts., 50,834 sq. yds., with Trinidad Lake asphalt has been awarded to the Kramer-Irwin Rock, Asphalt & Cement Paving Co., Toronto, at $2.59 per sq. yd., the other prices in the bid being as follows: Scoria blocks, $3.50 per sq. yd.; stone curbing, 89 cts. per lin. ft.; recutting and resetting old curbing, 60 cts.; new curbing without concrete, 70 cts.; old curbing redressed and with concrete, 50 cts. The other bids for the paving were as follows: Construction & Paving Co., Toronto, $2.98 (No. 1 Trinidad, $2.74); Warren-Scharf Asphalt Paving Co., Toronto, $3.21; Connolly & Co., Toronto, $2.82½ (No. 1 Trinidad, $2.69).

PIPE.—Napoleon, O.—J. B. Strawn, Engr., Salem, writes us that the Lake Shore Foundry, Cleveland, bid $18.60 per ton for furnishing cast iron pipe for the new water-works, and J. B. Clow & Son, Chicago, $18.90 for 4 and 6-in. pipe, $17.95 for 8 to 14-in., and 2¼ cts. per lb. for special castings.

WATER-WORKS. — Annapolis, Md.—The following bids were received by the Annapolis Water Co., July 19; Engrs., James H. Harlow & Co., Pittsburg, Pa.:

Pipelaying	Engineer's est.	Acock & Lane.	Malone Bros.	Owen Patterson.	Geo. S. Good.
16-in., 2,200 ft. at	$.25	$.32	$.25	$.45	$.35
14-in. 22,000 ft. at	.21	.27	.25	.38	.31
10-in. 600 " "	.25	.22	.25	.35	.25
8-in. 20 " "	.20	.18	.25	.30	.23
6-in. 50 " "	.18	.14	.25	.30	.19
Brick masonry, 10 M	8.00	9.00	..	12.00	8.00
Taking up 10-in pipe, 2,200 ft. at	.15	.10	..	.30	.15

	Duty.	Price.
Barr Pumping Eng. Co., Philadelphia	100,000,000	$6,000
E. P. Allis Co., Milwaukee	90,000,000	7,400
F. R. Dravo & Co., Pittsburg	90,000,000	7,500
" " " " "	82,500,000	6,900
" " " " "	67,500,000	6,300
Henry R. Worthington, New York	105,000,000	10,000
" " "	75,000,000	6,000
Deane Steam Pump Co., Holyoke	95,000,000	11,343
" " " " "	70,000,000	5,841
" " " " "	60,000,000	5,557
" " " " "	45,000,000	5,168
Snow Steam Pump Wks., Buffalo	100,000,000	10,750
" " " " "	55,000,000	4,975
Arthur J. L. Loretz, Brooklyn	115,000,000	15,000
" " " " "	108,000,000	12,000
" " " " "	60,000,000	8,000

Springfield, O.—The contract for a 5,000,000-gallon vertical triple expansion pumping engine has been awarded to the Edward P. Allis Co., Milwaukee, at $31,000, less $3,100 allowed for an old 3,000,000-gallon pump. The engine purchased has a guaranteed capacity of 6,000,000 gallons per day. The itemized bids recently received by the city for a 10,000,000-gallon engine were published in our issue of June 7.

ASPHALT PAVING.—Indianapolis, Ind.—Bids were opened July 25 for four contracts for paving with asphalt. Hugo Reid, 50 Wall St., New York, Pres. Trinidad Asphalt Refining Co., is reported to have submitted bids considerably lower than any others, but had failed to file samples of the Trinidad Lake asphalt upon which he bid and his bids were not considered. The Alcatraz Contracting Co., composed of local capitalists (Pres., Newton Claypool; Secy., J. W. Claypool), bid on California asphalt, which is not used in this city. The bids which were opened were as follows; the prices being per lin. ft.:

	—Width of paving.— 38 ft.	38 ft.	38 ft.	30 ft.
Western Paving & Supply Co.	$6.25	$6.54	$6.89	$4.27
Alcatraz Contracting Co.	7.19	7.72	8.13	5.19
Indiana Bermudez Asphalt Co.	6.42	6.96	7.20	4.66
Warren-Scharf Asphalt Co.	7.18	7.15	7.18	5.82

Erie, Pa.—The contract for paving Eighth St., from Cherry to Cascade Sts., with asphalt has been awarded to the Erie Paving Co., according to reports, at $2.75 per sq. yd. The Barber Asphalt Paving Co., Buffalo, bid $3.

blocks, and 22 cts. per lin. ft. for Ionia sandstone curbing 5 ins. thick. Mr. Hurley's bid was as follows:

Excavation, 1,888 cu. yds. (including ½ mile haul)	$.20
Embankment, sand, 466 cu. yds.	.25
Paving with cedar blocks, 6,959 sq. yds.	.36
" " Ross sapless block, 6,959 sq. yds.	.74
Berea curbstone, 4 × 18 ins., 3,162 lin. ft.	.34
Berea gutterstone, 4 × 12 ins., 20 lin. ft.	.34
Paving with cobblestones, 96 cu. yds.	.30
Aprons, 18 ins. × 7 ft. × 1¾ ins., 2	6.00
Cast iron grates, 10	2.50
24-in. sewer pipe, 168 ft.	.83
10-in " " 629 "	.22
10-on-24 T's, 5	3.23
Brick for catch basins, laid, 3 M	12.00
Excavation below subgrade (if required), per cu. yd.	.20
Gravel filling (if required), per cu. yd.	.35

SEWERS.—Mount Pleasant, Pa.—The only bids received for constructing a proposed sewer, that complied with the specifications, were those of (1) James McConagle, Jeannette, at $7,952, and (2) Owen Murphy, Mount Pleasant, at $9,893, according to the estimates of Neel & Shields, Borough Engrs.; the prices being as follows:

	1.	2.
12-in. pipe sewer, including Y's, etc., per lin. ft.	$.25	$.29
10-in. " " " " " "	.21	.25
8-in. " " " " " "	.17	.21
Excavation and back filling, to 6 ft.	.21	.40
" " " 6 to 8 ft.	.28	.55
" " " 8 to 10 ft.	.40	.70
" " " 10 to 12 ft.	.55	.85
" " " 12 to 14 ft.	.75	1.00
" " " 14 to 16 ft.	1.00	1.15
Rock trench, per ft. in depth, per lin. ft.	.16	.15
Manholes, brick, each	35.00	35.00
" wooden, each	20.00	15.00
Lampholes, each	4.00	7.00
Rockwork, per cu. yd.	2.00	2.00

Bids Received at Annapolis, Md., for Pipe and Valves.

	Pipe.*	Specials, 10 tons.	Valves. 16-in. 6	14-in. 9	10-in. 8	8-in. 1	6-in. 2	16-in. check. 20	Valve boxes,
Engineer's estimate	$19.50	$45.00	$60.00	$45.00	$24.00	$17.50	$11.75	$85.00	$2.75
Chattanooga Pipe Works	18.70	42.50	.....	.....	.....	.....	.....	.....	.....
R. D. Wood & Co.	21.00	40.00	64.00	55.00	25.00	18.00	12.60	75.00	2.50
Anniston Pipe Co.	19.00	42.50	58.00	48.00	20.50	18.75	10.55	....	3.75
Lester D. Wood & Co.	20.00	45.00	.....	.....	.....	.....	.....	.....	.....
Chapman Valve Mfg. Co.	....	....	62.94	49.96	27.66	18.21	12.30	82.96	....
Williamsport Valve Co.	....	....	65.20	48.80	25.20	18.00	12.00	....	....
Ludlow Valve Mfg. Co.	....	....	68.53	58.72	25.43	17.22	11.88	65.34	2.74
Rensselaer Valve Co.	....	....	58.00	48.00	23.00	16.50	11.00	75.00	2.50
Bingham & Taylor	....	....	.....	.....	.....	.....	.....	.....	**3.50

* 110 tons of 16-in., 1,000 tons of 14-in. and 10 tons of 6-in.
** 17 at $3.50, and 3 at $3.25.

PIPE, VALVES, ETC.—McDonald, Pa.—The successful bidders for the construction of the plant of the Citizens' Water Co. were noted last week under Water-Works. Potter & Folwell, Engrs., Pittsburg, write us that the contract for 1,700 tons of 12 to 4-in. pipe was awarded to the Anniston Pipe & Foundry Co., at $18.24 per ton; flange castings, $36; special castings, 2¼ cts. per lb. The bids for valves, double nozzle hydrants and valve boxes were as follows:

	Ludlow Valve Mfg. Co.	Rensselaer Mfg. Co.	Kelly, Jones & Co.	Mich. Brass & Iron Works.	Anniston Pipe & F'dry Co.	R. D. Wood & Co.
Valves.—12-in.	$30.10	$29.50	$25.65	$30.00	$29.00	$33.00
" 10-in.	23.78	23.00	18.50	21.50	23.50	24.00
" 8-in.	16.62	16.60	14.25	15.00	15.72	17.25
" 6-in.	11.10	10.80	8.55	10.40	10.65	11.75
" 4-in.	6.70	6.60	5.70	6.75	6.40	7.00
Hydrants	22.40	....	25.00	21.75	18.02	22.75
Valve boxes	2.60	2.60	4.00	2.50	2.80	2.60

PUMPING ENGINES.—McDonald, Pa.—The following bids were received July 18 for pumping machinery and boilers for the new water-works; contract awarded to Snow Steam Pump Co., as stated last week; Engrs., Potter & Folwell, Pittsburg:

Bids Received at McDonald, Pa., for Pumping Machinery and Boilers, showing Comparative Dimensions, Current Economy in Service and Estimated Commercial Value when Operated at Contract Speed, Interest Computed at 6% and Coal at $1.70 per ton of 2,000 lbs.

Bidder.	Class of engine.	Cylinders, ins. h. p.	l. p.	No. of cylinders	Water cyl., diam. ins.	Piston sp'd, ft. Str'ke ins.	No. of strokes per min.	Duty.* Evap'n, 10 lbs.	Steam pressure, 8 lbs.	80 lbs.	Price.	Annual tons of coal. Evap'n, 10 lbs.	Evap'n, 8 lbs.	Annual cost of coal. Evap'n, 10 lbs.	Evap'n, 8 lbs.	5% interest on plant.	Total annual cost, interest and coal. Evaporation, 10 lbs.	8 lbs.
[1]Laidlaw-Dunn-Gordon	Direct.	20	36⅝	4	14	30	90	55	44	80	$10,103	1,463.18	1,829.00	$2,487.41	$3,109.30	$606.18	$3,094	$3,715
" " "	"	14	26	4	10¼	18	90	55	44	80	9,885	1,463.18	1,829.00	2,437.41	3,109.30	593.10	3,031	3,702
[1]Fraser & Chalmers	Flywheel.	20	32	2	..	30	300	60	80	64	80	17,000	1,005.94	1,257.40	1,710.10	2,137.58	1,020.00	2,730	3,158
[1]Wilson Snyder	Direct.	19	34	4	14	24	90	22½	50	40	100	9,300	1,609.50	2,011.90	2,737.15	3,420.23	558.00	3,295	3,978
[1]Deane Steam Pump Co.	"	18	36	4	14	24	90	22½	55	44	80	11,351	1,463.20	1,829.00	2,487.41	3,109.30	681.06	3,168	3,790
[1]Henry R. Worthington	"	19¼	33⅜	4	13	24	105	26¾	55	44	80	13,000	1,463.20	1,829.00	2,487.41	3,109.30	780.00	3,267	3,889
" " "	"	18	36	4	12½	24	115	28⅝	100	80	100	18,875	804.80	1,006.00	1,368.16	1,710.20	1,132.50	2,500	2,843
[1]Snow Steam Pump Co.	"	18	32	4	13½	18	100	33⅓	55	44	80	8,675	1,463.20	1,829.00	2,487.41	3,109.30	520.50	3,008	3,630
[2]Laidlaw-Dunn-Gordon	"	14	26	4	10¼	18	90	30	55	44	80	5,420	731.60	915.00	1,243.72	1,555.00	325.20	1,569	1,880
[2]Fraser & Chalmers	Flywheel.	12½	20	2	..	24	300	75	70	56	80	7,000	574.80	718.50	977.16	1,221.45	420.00	1,397	1,641
[2]F. R. Dravo & Co.	"	18	..	1	7½	40	303	45²⁄₃₀	75	60	100	5,700	536.50	670.60	912.05	1,140.02	342.00	1,254	1,482
[2]Deane Steam Pump Co.	Direct	12	22	4	10	18	90	30	55	44	80	7,200	731.60	915.00	1,243.72	1,555.00	437.40	1,681	1,992
[2]Henry R. Worthington	"	12	20	4	10	15	90	36	55	44	80	4,900	731.60	915.00	1,243.72	1,555.00	294.00	1,538	1,849
" " "	"	9	14	6	9½	18	100	33⅓	70	56	100	7,400	574.80	718.50	977.16	1,221.45	444.00	1,421	1,665
[3]F. R. Dravo & Co.	Flywheel.	16	30	2	6½	36	305	50⅘	100	80	100	9,000	603.60	754.50	1,026.12	1,282.65	540.00	1,566	1,823
[4]F. R. Dravo & Co.	"	16	..	1	6½	36	305	50⅘	75	60	100	5,000	402.40	503.00	684.08	855.10	300.00	984	1,155

[1] Capacity of 2,000,000 gallons.
[2] " " 1,000,000 "
[3] " " 1,500,000 "
[4] " " 750,000 "

* Million gallons, ft. lbs. per 100 lbs. of coal.

Marion, Ind.—The following bids have been received for furnishing a 4,000,000-gallon pumping engine, according to local papers; domestic pressure of plant, 40 lbs. to the sq. in., and fire pressure from 100 to 125 lbs.:

Stilwell-Bierce & Smith-Valle Co., Dayton O.	$7,373
Fairbanks, Morse & Co., Chicago	7,490
Deane Steam Pump Co., Holyoke, Mass.	8,180
Snow Steam Pump Co., Indianapolis	8,975
Laidlaw-Dunn-Gordon Co., Cincinnati	8,200

Bloomington, Ill.—The following bids have been received for a 4,000,000-gallon pumping engine, according to press reports:

Geo. F. Blake Mfg. Co.	$9,000
Henry R. Worthington	10,000
Stilwell-Bierce & Smith-Valle Co.	8,200
Edward P. Allis Co.	17,000
Deane Steam Pump Co.	11,000

Annapolis, Md.—The following bids were received by the Annapolis Water Co., July 19, for furnishing and erecting one 2,000,000-gallon high-duty pumping engine; Engrs., Jas. H. Harlow & Co., Pittsburg, Pa.:

Peoria, Ill.—The following bids were received July 17 for paving nearly 30,000 sq. yds. in Perry St. with asphalt:

Warren-Scharf Asphalt Paving Co., per sq. yd.	$2.26
Trinidad Asphalt Refining Co., New York "	2.03
Fruin-Bambrick Co., St. Louis (aw'd con't) "	1.85

STONE PAVING.—Meriden, Conn.—The contract for paving about 3,000 sq. yds. in East Main St. has been awarded to James Kane & Sons, at $3.40 per sq. yd., the Diamond Hill stone to be used. The Lines company bid $3.42 for this kind of stone. Only bids from local contractors were considered.

FILLING—Barrington, R. I.—Thos. Kieran, Engr., Fall River, Mass., writes us that the contract for about 10,000 cu. yds. of earth filling and 1,050 cu. yds. of riprap in connection with the proposed bridge across the Barrington River has been awarded to Anthony Corcoran, Providence, R. I., at 19½ and 24½ cts. per cu. yd.

WOOD PAVING.—Ionia, Mich.—The city received eight bids for paving West Main St. with cedar blocks, the contract being awarded to James Hurley, Bay City, at 36 cts. per sq. yd. for paving with common cedar

METAL MARKET PRICES.

LEAD.—New York: 3.55 to 3.6 cts. Chicago: 3.2 to 3.4 cts. St. Louis: 3.3 to 3.35 cts.

NAILS.—Pittsburg: $1.15 for wire, and 95 cts. to $1 for cut at mill, in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $2.05 to $2.10; plain, $1.40; carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $13. Pittsburg: $10.75 to $12. Chicago: $9.50 to $11.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.5 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square and 2.1 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.7 to 1.8 cts.; track bolts, 2.1 to 2.15 cts., with hexagon nuts.

RAILS.—New York: $24 to $25 at eastern mills and at tide water; old rails, $11 to $11.50 for iron, and $10 for steel; steel rails fit for relaying, $16 to $16.50; light rails, $22 to $24; girder rails, $21 to $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $11 for iron and $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.4 to 1.5 cts.; channels, 1.4 to 1.5 cts.; angles, 1.3 to 1.35 cts.; tees, 1.5 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.35 to 1.4 cts. for tank, 1.4 cts. for shell, 1.45 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.3 cts.; channels, 1.25 to 1.3 cts.; angles, 1.2 to 1.35 cts.; tees, 1.35 to 1.4 cts.; universal mill plates, 1.2 to 1.35 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.4 cts. for shell, 1.45 cts. for flange, 2.5 to 3 cts. for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.45 cts.; tees, 1.65 cts.; universal plates, 1.45 cts.; steel plates, 1.45 to 1.55 cts. for tank, 1.5 to 1.6 cts. for shell, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Aug. 3.	Bridge, Red Wing, Minn.		July 12
	Advertised, Eng. News, June 21 and 28.		
Aug. 3.	Flagging,	Brooklyn, N. Y.	July 26
Aug. 4.	Street improvements,	Mansfield, O.	July 12
Aug. 4.	Brick paving,	Belleville, Ill.	July 26
	Advertised, Eng. News, July 26.		
Aug. 4.	Steel water tanks,	Oil City, Pa.	Aug. 2
Aug. 4.	Water bonds ($30,000),	Aurora, Ill.	Aug. 2
Aug. 5.	Water bonds ($500,000),	Portland, Ore.	July 26

Aug. 6.	Electric lighting, Rome, N. Y.	June 14
Aug. 6.	Bridge (50-ft.), Vicksburg, Miss.	July 19
Aug. 6.	Levee work, Donaldsonville, La.	July 19
Aug. 6.	Street improvements, Marion, O.	July 19
Aug. 6.	Macadamizing, Toledo, O.	July 19
Aug. 6.	Bridges, Leavenworth, Kan.	July 19
Aug. 6.	Water-works and bonds, Harvard, Neb.	July 19
Aug. 6.	Asphalt or brick paving, Houston, Tex.	July 19
Aug. 6.	Bridge, Austin, Tex.	July 26
Aug. 6.	Paving, Albany, N. Y.	Aug. 2
Aug. 6.	Pipe sewers, Albany, N. Y.	Aug. 2
Aug. 6.	Asphalt paving, Jersey City, N. J.	Aug. 2
Aug. 6.	Cement (12,000 bbls.), Atlanta, Ga.	Aug. 2
Aug. 6.	Brick sewers, Toledo, O.	Aug. 2
Aug. 6.	Water supply, Pictou, N. S.	Aug. 2
Aug. 7.	Cast iron pipe, Hoboken, N. J.	July 19
Aug. 7.	Granite paving, Cincinnati, O.	July 19
Aug. 7.	Arch, Cohoes, N. Y.	July 26
Aug. 7.	Water pipe, etc., St. Louis, Mo.	July 26
Aug. 7.	Irrigation bonds, Winchester, Cal.	July 26
Aug. 7.	Grading, East Cambridge, Mass.	Aug. 2
Aug. 7.	Macadamizing, Boston, Mass.	Aug. 2
Aug. 8.	Bridge, Cleveland, O.	July 12
Aug. 8.	Dredging, Washington, D. C.	July 26
Aug. 8.	Sewers, New York, N. Y.	Aug. 2
Aug. 9.	Buildings, Columbus, O.	July 19
Aug. 9.	Brick paving (12,635 sq. yds.), Lima, O.	July 19
Aug. 9.	Sewer, Brooklyn, N. Y.	Aug. 2
Aug. 9.	Tube well plant, Lowell, Mass.	Aug. 2
	Advertised, Eng. News, Aug. 2.	
Aug. 9.	Stone curbing (13 Sts.), Danville, Ill.	July 19
Aug. 9.	Water-works system, Fullerton, Neb.	July 26
Aug. 9.	Water bonds ($12,500), Fullerton, Neb.	July 26
Aug. 10.	Bridges, Cincinnati, O.	July 26
	Advertised, Eng. News, July 19 to Aug. 2.	
Aug. 10.	Water-works extensions, Syracuse, N. Y.	July 26
	Advertised, Eng. News, July 26.	
Aug. 10.	Asphalt paving, Troy, N. Y.	Aug. 2
Aug. 10.	Stone gutters, Baltimore, Md.	Aug. 2
Aug. 10.	Steel tanks, Savannah, Ga.	Aug. 2
Aug. 10.	Sewers, Fostoria, O.	Aug. 2
Aug. 10.	Bridge, Nevada, Mo.	Aug. 2
Aug. 10.	Pumping plant, etc., Blair, Neb.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Aug. 10.	Stand-pipe, pipe, etc., Oak Cliff, Tex.	Aug. 2
Aug. 10.	Hdyrants (24), Dallas, Tex.	Aug. 2
Aug. 11.	Sewers, Sandusky, O.	July 19
Aug. 11.	Trenching, Olean, N. Y.	July 26
Aug. 11.	Electric lighting, Youngstown, O.	July 26
Aug. 11.	Sewage pumping station, Boston, Mass.	Aug. 2
Aug. 11.	Sewer materials, Rochester, N. H.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Aug. 11.	Sewers, Rochester, N. H.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Aug. 11.	Cast iron pipe, Washington, D. C.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Aug. 11.	Pipe sewers (8,300 ft.), Alliance, O.	Aug. 2
Aug. 13.	Telegraph material, Washington, D. C.	July 26
Aug. 13.	Macadamizing, Cincinnati, O.	July 26
Aug. 13.	Sidewalks (15 streets), Houston, Tex.	July 26
Aug. 13.	Macadamizing (4,000 lin. ft.), Laurel, Md.	Aug. 2
Aug. 13.	Boilers, Toledo, O.	Aug. 2
Aug. 13.	Pipe sewers, Huntington, Ind.	Aug. 2
Aug. 14.	Brick paving, Cincinnati, O.	July 26
Aug. 14.	Sewers, Buffalo, N. Y.	Aug. 2
Aug. 14.	Wells, etc., Springfield, O.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Aug. 14.	Brick sidewalks, Huntington, Ind.	Aug. 2
Aug. 14.	Buildings, Ames, Ia.	Aug. 2
Aug. 14.	Fire engine, Dubuque, Ia.	Aug. 2
Aug. 15.	Architectural competition, Atlanta, Ga.	July 12
Aug. 15.	Water-works bonds, Hillsboro, O.	July 19
Aug. 15.	Sewer bonds ($10,000), Riverside, O.	July 19
Aug. 15.	Electric l't plant, Summerside, P. E. I.	July 19
Aug. 15.	Paving (15,310 lin. ft.), Ironton, O.	July 26
Aug. 15.	Pumping stations, Brooklyn, N. Y.	July 26
	Advertised, Eng. News, July 26.	
Aug. 15.	Highway, Dartmouth, Mass.	Aug. 2
Aug. 15.	Highways, New York, N. Y.	Aug. 2
Aug. 15.	Water-works system, Aberdeen, Md.	Aug. 2
	Advertised, Eng. News, Aug. 2.	
Aug. 15.	Court house, Bayfield, Wis.	Aug. 2
Aug. 15.	Electric lighting, Trenton, Ont.	Aug. 2
Aug. 15.	Electric light plant, Trenton, Ont.	Aug. 2
Aug. 16.	Water-works bonds, Glendale, O.	July 19
Aug. 16.	Brick sewers (1,330 ft.), Ironton, O.	July 26
Aug. 16.	Pipe sewers (14,296 ft.), Ironton, O.	July 26
Aug. 17.	Pipe sewers (1,559 ft.), Avondale, O.	July 26
Aug. 18.	Water ext'n bonds ($2,000), Clifton, O.	Aug. 2
Aug. 20.	Cement, Pittsburg, Pa.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.	
Aug. 20.	Water-works system, Morganfield, Ky.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.	
Aug. 20.	Paving, Toledo, O.	Aug. 2
Aug. 20.	Plans for jail, Waukegan, Ill.	Aug. 2
Aug. 20.	Dams, San Francisco, Cal.	Aug. 2
Aug. 22.	Drainage canal, Chicago, Ill.	June 28
	Advertised, Eng. News, June 28 to Aug. 14.	
Aug. 22.	Pmpg eng. house, etc., New York, N. Y.	July 26
Aug. 22.	Sewer work, Cleveland, O.	Aug. 2
Aug. 23.	Artificial stone walks, Cincinnati, O.	Aug. 2
Aug. 23.	Electric light plant, Estherville, Ia.	Aug. 2
	Advertised, Eng. News, Aug. 2.	
Aug. 23.	Highway bridge, Omaha, Neb.	Aug. 2
Aug. 24.	Fireproof building, Fairfax, Va.	July 26
	Advertised, Eng. News, July 26 to Aug. 16.	
Aug. 24.	Disinfecting plant, Washington, D. C.	Aug. 2
Aug. 24.	Grading (12 miles), Wapakoneta, O.	Aug. 2
Aug. 25.	Dredging, Wilmington, N. C.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 23.	
Aug. 25.	Sewers, Marietta, O.	Aug. 2
Aug. 27.	Canal, etc. (5 miles), Chicago, Ill.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 23.	
Aug. 28.	Removing wreck, Boston, Mass.	Aug. 2
Aug. 31.	Reservoir, Cambridge, Mass.	Aug. 2
	Advertised, Eng. News, Aug. 2 and 9.	
Sept. 1.	Pipe, pump, etc., Honolulu, H. I.	July 19
	Advertised Eng. News, July 19 to Aug. 2.	
Sept. 1.	Electric lighting, Portland, Ore.	June 21
Sept. 1.	Electric lighting, Toronto, Ont.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.	
Sept. 1.	Electric light plant, Toronto, Ont.	Aug. 2
	Advertised, Eng. News, Aug. 2 to 16.	
Sept. 3.	Bridge, Dillon, Mont.	July 5
No date.	Iron cylinders, New York, N. Y.	July 26
	Advertised, Eng. News, July 26.	
"	" Franchises, Texarkana, Tex.	July 26
	Advertised, Eng. News, July 26.	
"	" Water-works system, Rankin, Pa.	July 26
"	" Pipe, valves, Macungie, Pa.	Aug. 2
"	" Water-wks. franchise, Oxford, Miss.	Aug. 2

INDUSTRIAL NOTES.

RAILWAY EQUIPMENT.—A narrow gage locomotive and 30 flat cars are wanted by the Mexican Industrial Co., of Chihuahua, Mexico.

THE GRIFFITH & McDERMOTT CONSTRUCTION CO., Lakeside Bldg., Chicago, has been incorporated for carrying on a general construction business. Pres., M. McDermott; Vice-Pres. and Gen. Man., Frank J. McCain; Secy. and Treas., J. Griffiths.

RITER & CONLEY, of Pittsburg, Pa., have a contract for the erection of two iron tanks for the Water Department of Allegheny, Pa. They will be 40 ft. diameter and 22 ft. high. One is to rest on a stone and timber foundation and the other on a steel tower 28 ft. high. The firm is also constructing 24 marine boilers, 8½ ft. diameter, for Philadelphia.

THE LIDGERWOOD MFG. CO., of New York, reports that there are now 14 traveling cableways purchased for use on the Chicago drainage canal. The Des Plaines Construction Co. has started up four, which were contracted for recently. McArthur Bros. have just placed an order for two, and the work of building the towers and cars is now under way.

GRAY COLUMNS.—A contract has been awarded to J. H. Gray, C. E., New York Life Building, Chicago, for furnishing Gray columns for a new 12-story building to be erected at Van Buren St. and Wabash Ave., Chicago. These columns are now in use in several buildings, including the Reliance Building, Chicago, 14 stories; Tarrant Co. (Texas) Courthouse; Chamber of Commerce, Detroit, 12 stories; Wyandotte Building, Columbus, O., 10 stories.

NEW COMPANIES.—American Purchase & Supply Co., East St. Louis, Ill.; $500,000; T. C. Hughes, W. F. Richards and Charles Hoyle.——Keystone Wooden Pipe & Contracting Co., San Diego, Cal.; $250,000, with $10 paid in; L. B. Harris, S. A. Hammond and George Wade.——Morton Life & Limb Saving Car Fender Co., Baltimore, Md.; $2,000,000; George A. Chase, J. F. Morton and S. A. Moore.——Pierce Germ-Proof Filter & Hydrant Co., Bloomington, Ill.; $500,000; Joseph H. Pierce, W. Rockwell and H. M. Conger.——Harrison Interstate Telephone & Telegraph Co., Frederick, Md.; $25,000; Dr. P. D. Fahrney, J. E. Walker and E. L. Miller.——Standard Telegraph & Telephone Co., Cleveland, O.; $50,000; Frank Rockefeller, F. B. Squire and L. H. Severance.——Chickasaw Asphalt Co., Fort Worth, Tex.; $500,000; Nat. Smith and Thomas Connyngton.——Coffin Valve Co., Kittery, Me.; $50,000; Pres., Zebulon B. Coffin, Boston, Mass.——Pettibone Mfg. Co., Cincinnati, O.; Fitzsimmons telephones; $100,000; James Pettibone and R. N. Archer.——El Reno Bridge Co., Guthrie, Okla.; $25,000; W. E. Tryberger, F. E. Gillett and N. Esperson.——Puente Oil Pipe Line Co., Los Angeles, Cal.; $100,000; William Lacy, W. R. Rowland and W. J. Broderick.——Ogden Iron Mining & Mfg. Co., Ogden, Utah; Pres., M. Poulter; Secy., O. A. Kennedy.——Alcatraz Asphalt Co., San Francisco, Cal.; $1,600,000; W. N. Cowles, A. C. Ferry and Harold Wheeler.——Natural Gas Saving Co., Niagara Falls, N. Y.; $16,000; W. C. Edwards, W. H. Orchard and W. O. Langs.

MUNICIPAL BOND MARKET.

New York, July 31, 1894.

The past week has witnessed a very gratifying change in the character of the municipal bond market since a demand has sprung up for first-class investments. The revelations made public as to certain phases of railroad management have made railroad mortgages more unpopular with small investors than ever, and the disgust brought about by the continued decline of this class of bonds has been turned to good account by the dealers in municipal bonds, who are taking good care to impress on would-be investors the safety hedging around these securities. The good investment buying that has accordingly set in is giving the specialists about as much business as they can handle, and in many instances the orders have been difficult of execution.

Naturally this active demand has resulted in a continuation of high prices for municipal bonds. It might be well here to quote some prices at which bonds are selling and determine the small percentage of income they yield the holder at the purchase price. Philadelphia City 6s of 1900 bring 115½, netting the holder 3 per cent.; Pittsburg water loan 7s of 1898 sell for 114½, yielding at this figure 3¼ per cent.; Allegheny City 4s of 1924 are quoted at 109½, netting the purchaser 3½ per cent. on his investment. The city of Detroit, Mich., sold $200,000 4 per cent. 30-year bonds at 110½, yielding 3.45 per cent. income. Monroe county, N. Y., sold $200,000 3½ per cent. 12-year bonds at 109¾, yielding 3.40 per cent. income, and Sunbury, Pa., sold $10,000 3½ per cent. bonds at 100. These bonds have been principally sold to bond dealers and the investor will net even less on his money when they are resold to him.

Of course the bonds quoted are first-class securities and not all municipal bonds command any such good prices. None the less the bond dealers find lots of customers for such securities among cautious people, who prefer to sacrifice a bit of revenue to the sense of security they have in buying these gilt-edge securities. There are lots of other good municipal bonds on the market netting 4 to 4½% on the investment, but the higher priced securities are just as much sought after. Of course, many of them are purchased for trust funds, but investors of the kind mentioned above often buy them for their own account.

The Chicago Drainage Board, whose recent offering of $3,000,000 4% bonds at par and accrued interest, proved such a fiasco, has decided to again offer the issue, but the rate of interest will be raised to 5%, the same rate that the two previous issues of these bonds bear. It is expected that the upset price of the Board will this time be realized. It will be remembered that the recent offering met with but one bid, that of the Illinois Savings & Trust Co., whose offer of par and interest, less a commission of $180,000, put the price at 96. It is a most significant criticism of Chicago's credit to compare this price with that of the 4% bonds quoted above, the Allegheny City 4s bringing 109½, and the Detroit 4s selling for 110¾. The last 5% drainage bonds sold by Chicago brought 101.79. As furnishing interested parties an indication to the credit of various municipalities, the following quotations of current offerings are appended.

MUNICIPAL BONDS.

	Price
City of Pueblo, Col., Gen. Fund 6s	113
County of Flathead, Mont., 20-year, Gold 6s	107½
City of Bartow, Fla., 20-year 6s	102
Williamsbridge, N. Y., Highway 6s	136¼
City of Bethany, Mo., Gold 6s	105½
Knightstown, Ind., 6s	111½
County of Park, Mont., Gold 6s	109¼
County of Fergus, Mont., Gold 6s	106
City of New Whatcom, Wash., Gold 6s	105½
School District of Brainerd, Minn., 6s	108½
City of Meridian, Miss., 6s	107½
County of Bexar, Tex., Gold 6s	103½
City of Omaha, Neb., 5s	111
City of Jefferson, Ia., 5s	102½
City of Hastings, Neb., 5s	102
City of Salt Lake, Utah, Gen. Fund 5s	103¼
City of Tacoma, Wash., 20-year 5s	101
City of Dayton, O., School 5s	107½
County of Portage, Wis., Refunding 5s	107½
City of Findlay, O., School 5s	105
City of Sheldon, Ia., School 5s	101½
City of Brooklyn, N. Y., Pub. Market 4s	110¼
City of Elmira, N. Y., 4s	105½
City of Niagara Falls, N. Y., Sewer 4s	105½
City of Auburn, N. Y., 4s	108½
City of Cleveland, O., 4s	104½
City of Manchester, N. H., 4s	106½
Town of Methuen, Mass., 4s	107
City of Waterbury, Conn., 4s	103½
City of Chicago, Ill., Gold 4s	104¼

RAILWAY STOCK MARKET.

New York, July 31, 1894.

Speculation in railway stocks has become so dull that any prognostication of the future must be founded on other than Stock Exchange conditions. Not that quotations are suffering much from this continued lack of activity; the whole course of the stock market of late has demonstrated what to Wall Street experience is a remarkable fact, that, when dealings dwindle, stocks become comparatively firm. And this contrary state of affairs is made more and more patent every day.

The feature of the railway stock for the week ending with the present writing has been the vicious attacks on the Granger stocks, as a result of the unfavorable crop advices from the West. The destruction of the corn crop by hot winds in sections of Nebraska, Colorado, Kansas and Iowa is a genuine calamity. Viewed from a speculative standpoint the disaster is a very depressing bear factor. Several dividends were seriously enough threatened by the recent strike's interruption with business, but the inroads on earnings presaged by crop failures will be big enough—if the reports are not distorted or exaggerated—to make the non-payment of the dividends in question an absolute certainty. It is on fears of this nature that Burlington, Rock Island & St. Paul are being so freely sold; what support is rendered comes from inside sources, but other people are more inclined to sell the Granger stocks than to buy them.

A disposition has manifested itself of recent days to sell the high-priced railway shares, like Lake Shore Lackawanna and Delaware & Hudson. It is argued that the recent unfortunate developments in the Atchison property must result in Europeans selling not only their speculative, but also a good part of their investment holdings of American railway securities. In any such liquidation of investment accounts, the Vanderbilts and other first-class stocks must suffer. The bear clique made an effort to-day to start this movement toward lower prices by offering the stock down on seller-sixty option. It was alleged by brokers active in it that some long stock came out during the day, but this is all that the movement has so far resulted in.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices July 31.
Alton & Terre Haute	28
Atchison, Topeka & Santa Fe	3⅞
Baltimore & Ohio	71
Canada Southern	48½
Chesapeake & Ohio	16¾
Chicago, Burlington & Quincy	73
Chicago & Northwestern	102¾
Chicago, Milwaukee & St. Paul	57½
Chicago, Rock Island & Pacific	64½
Cleveland, Cincinnati, Chicago & St. Louis	34½
Delaware, Lackawanna & Western	162
Delaware & Hudson	132¾
Lake Shore & Michigan Southern	129½
Louisville & Nashville	45½
Missouri Pacific	24½
Missouri, Kansas & Texas	12⅝
Mobile & Ohio	18
New Jersey Central	106½
New York Central	96½
New York & New England	6
New York, New Haven & Hartford	181
New York, Chicago & St. Louis, 1st pfd	69
New York, Lake Erie & Western	13⅞
New York, Ontario & Western	14½
New York, Susquehanna & Western	14
Northern Pacific	3½
Northern Pacific, pfd	13
Philadelphia & Reading	17
Richmond Terminal	14½
St. Paul & Omaha	34½
Southern Pacific	17½
Texas Pacific	8¼
Union Pacific	7¾
Wabash pfd	13¾
Wheeling & Lake Erie	9¾

BOSTON RAILWAY STOCKS.

	July 31.
Boston & Albany	205½
Boston & Maine	147
Fitchburg	69½
Old Colony	179

PHILADELPHIA RAILWAY STOCKS.

	July 31.
Lehigh Valley	37½
Pennsylvania Railroad	48⅞